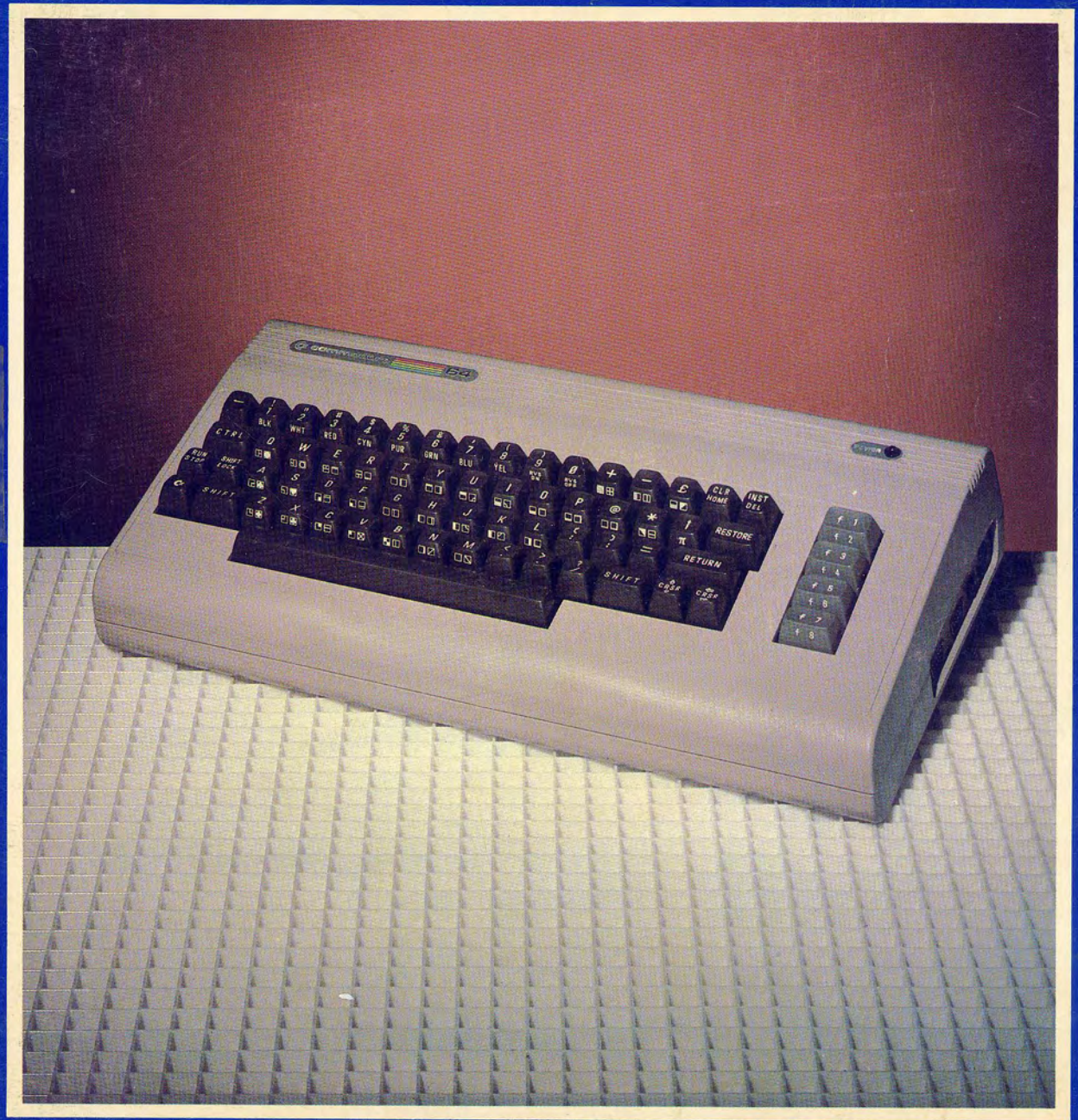
SAMS COMPUTERFACTS™ CC4

# COMPUTER : COMMODORE 64™




TECHNICAL SERVICE DATA FOR YOUR COMPUTER

# PRELIMINARY SERVICE CHECKS

This data provides the user with a time-saving service tool which is designed for quick isolation and repair of computer malfunctions.

Check all interconnecting cables for good connection and correct hook-up before making service checks.

Disconnect all peripherals except the monitor from the computer to eliminate possible external malfunctions. However, problems involving the interaction between computer and a peripheral will require the connection of the device for voltage and logic readings.

Replacement or repair of the keyboard, main board, RF Modulator, or components may be necessary after the malfunction has been isolated.

# GENERAL OPERATING INSTRUCTIONS

## POWER UP

When the computer is turned On, it will come up ready to program in Commodore Basic. See "Cassette Operation" or "Disk Operation" for instructions on loading and saving programs. To run a program, type RUN and press the RETURN key. To stop a program, press the RUN/STOP key. Pressing the RUN/STOP key and RESTORE key at the same time will stop the program and reset the computer to the start condition, without losing the program.

## CASSETTE OPERATION

Plug a Datassette cassette recorder onto the six pin edge connector at the rear of the computer. Note: A regular tape recorder will not work on the Commodore 64. To load a program, type LOAD, press the RETURN key and follow the instructions displayed on the monitor screen. To save a program, type SAVE, press the RETURN key and follow the instructions displayed on the screen.

## DISK OPERATION

Connect Disk Drive Unit to the Serial Port located at the rear of the computer. Carefully insert the disk so that the label on the disk is facing up and the notch on the disk is on the left side. Once the disk is inserted, close the protective gate by pushing down on the gate lever. To load a program from the disk, type LOAD "PROGRAM NAME", 8. Press the RETURN key and follow the instructions displayed on the monitor. To SAVE a program, type SAVE "PROGRAM NAME", 8 and press the RETURN key. Note: 8 is the code for the disk.

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CC4 COMMODORE MODEL 64

# PRELIMINARY SERVICE CHECKS (Continued)

## SERVICE CHECKS

SEE INTERCONNECTING DIAGRAM, PLACEMENT CHART, AND PHOTOS TO MATCH THE NUMBER IN THE CIRCLES WITH THOSE IN THE FOLLOWING DATA FOR SERVICE CHECKS TO BE PERFORMED.

### ① RF MODULATOR CHECK

(A) Turn On computer and verify the power indicator LED is lit. Note: If the power indicator LED is not lit, see the "Power Supply Check" and "Main Board (Power Check)" sections.

(B) Verify the channel select switch is on the same channel as the monitor, channel 3 or 4.

(C) Verify the antenna switch is in Computer position.

(D) Check for bad connections and improper hook-up at the monitor and at the computer.

(E) If the computer still does not come up when powered, check the voltages at the RF Modulator connection points. If the voltages are correct, substitute the RF Modulator.

### ② POWER SUPPLY CHECK

(A) Connect Power Supply to 120VAC. Disconnect power connector CN7 from computer. Check for 10.90VAC across pins 6 and 7 of CN7.

(B) Check for 5.08V across pins 2 and 4 of CN7. If the voltages are not present or are incorrect, replace the power supply.

### ③ MAIN BOARD (POWER CHECK)

(A) If the power indicator LED does not light when computer is powered, check the Fuse F1 and the Power Switch (SW1).

(B) Check for 11.77V at the Bridge Rectifier (CR4).

(C) Check for 4.93V at pin 2 of Voltage Regulator VR2.

(D) Check for 4.93V at Coil L2.

(E) Check for 4.91V at Coil L5.

(F) Check for 11.76V at pin 2 of Voltage Regulator VR1.

## TEST EQUIPMENT AND TOOLS

### TEST EQUIPMENT

Digital Volt/Ohm Meter
Logic Probe

### TOOLS

Small Screwdriver
Phillips Screwdriver
Soldering Iron
Desoldering Equipment
Switch Cleaner (non-spray type)

### ④ MAIN BOARD (PROCESSING)

(A) If the power supply checks normal and the computer does not come up when powered, verify Microprocessor IC (U7) is working by checking for pulses on pins 7 thru 20, 22, 23, and 30 thru 37.

(B) If the Microprocessor is working and the computer does not come up, check by substitution Kernal ROM IC (U4), Program Logic Array IC (U17) and Video Interface Chip IC (U19).

(C) No audio. Check Sound Interface Device IC (U18) by substitution.

(D) Disk Drive or Printer does not function properly. Check Complex Interface Adapter IC (U2) by substitution.

(E) Datassette cassette does not operate. Check Complex Interface Adapter IC (U1) by substitution.

(F) Audio/Video Port does not work. Check Sound Interface Device IC (U18), and Video Interface Chip IC (U19) by substitution.

(G) Keyboard does not operate. Check Complex Adapter IC (U1) by substitution. Also see "Keyboard" section.

(H) Modem does not operate. Check both Complex Interface Adapter IC's (U1 and U2) by substitution.

(I) Cartridge Port does not work. Check by substitution Program Logic Array IC (U17) and Kernal Rom IC (U4).

(J) Control Ports do not work. Check Complex Interface Adapter IC (U1) by substitution.

### ⑤ KEYBOARD

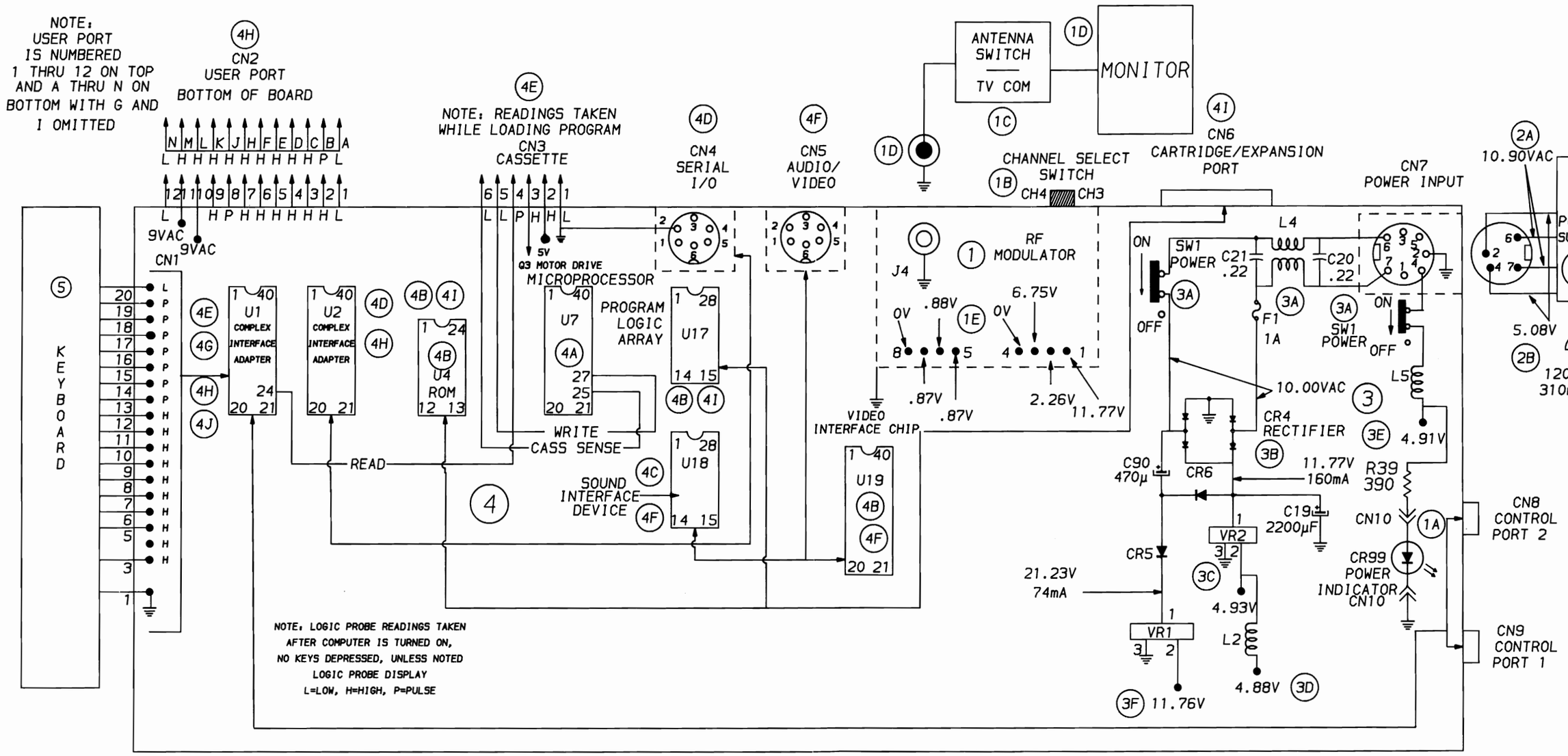
Substitute the keyboard or locate the bad key and carefully clean the key switch with switch cleaner.

## REPLACEMENT PARTS

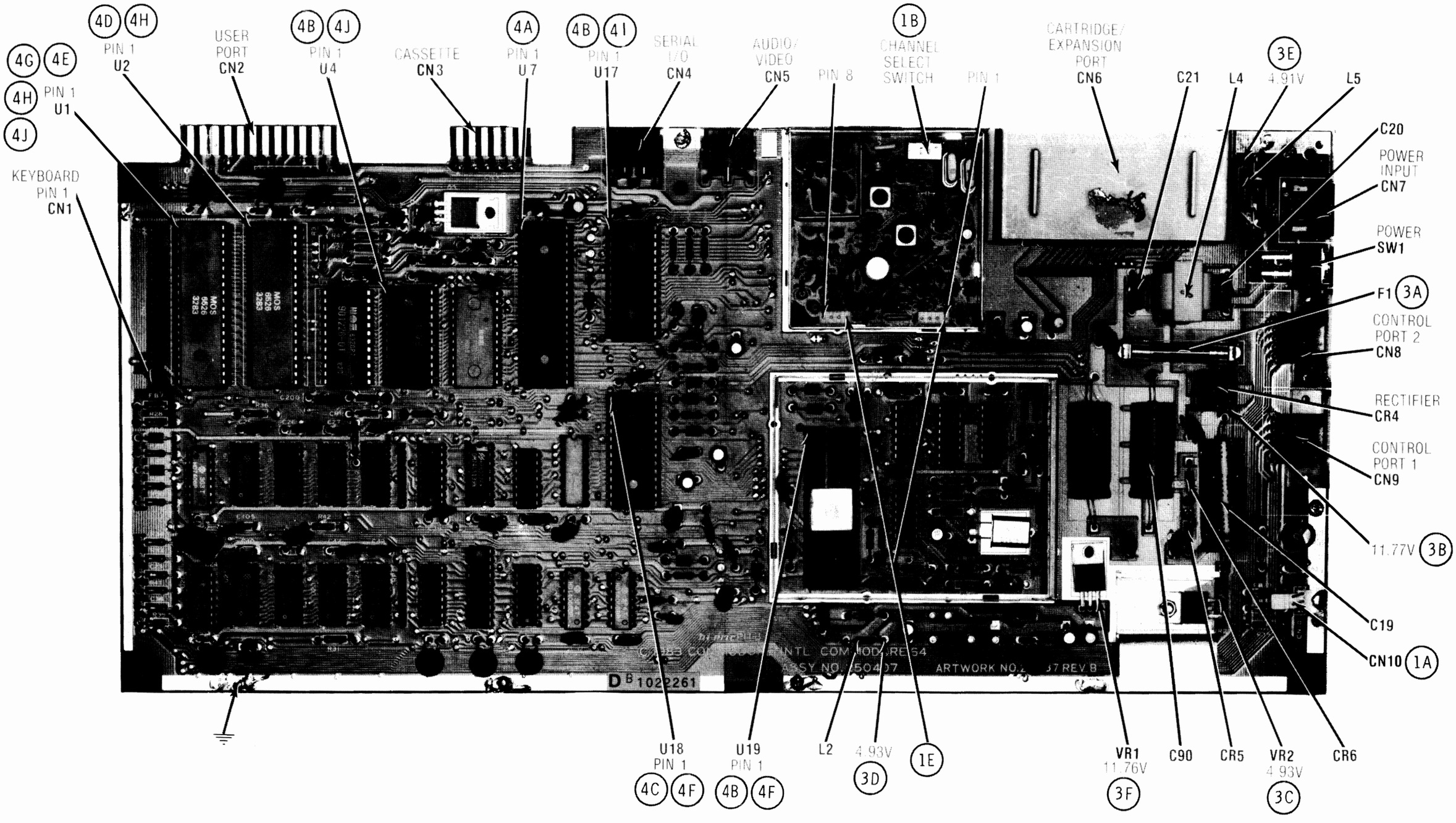
Power Supply for Commodore 64
Fuse 1A 250V 3AG
Bridge Rectifier CR4, Diodes CR5, CR6

| IC | TYPE NO. | IC | TYPE NO. |
|---|---|---|---|
| U1 | 6526 | U18 | 6581 |
| U2 | 6526 | U19 | 6567R8 |
| U4 | 901227-02 | VR1 | AN7812 |
| U7 | 6510CBM | VR2 | AN7805 |
| U17 | 906114-01 | | |

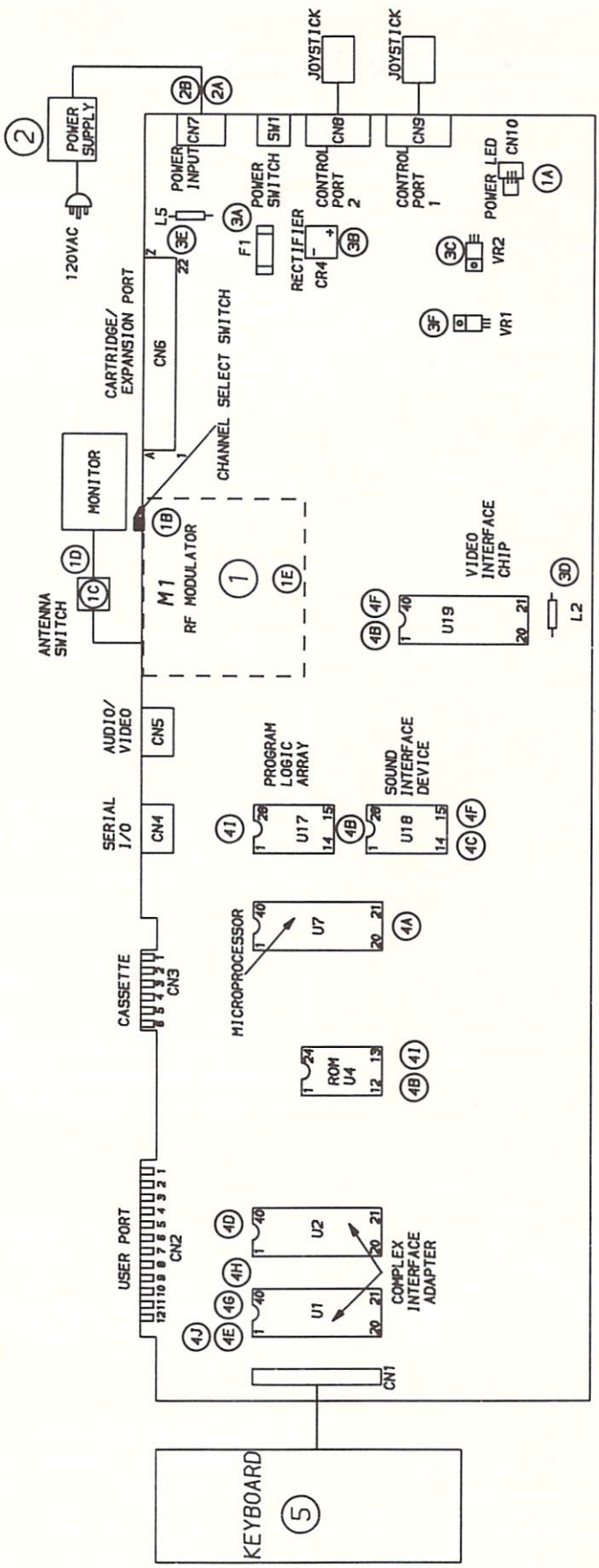
PRELIMINARY SERVICE CHECKS (Continued)



PRELIMINARY SERVICE CHECKS (Continued)



SEE PAGE III


JOYSTICK
JOYSTICK
POWER SUPPLY
120VAC
POWER INPUT CN7
POWER SWITCH SW1
CONTROL PORT 2 CN8
CONTROL PORT 1 CN9
POWER LED CN10
L5
F1
RECTIFIER CR4
VR2
VR1
CARTRIDGE/ EXPANSION PORT CN6
CHANNEL SELECT SWITCH
MONITOR
M1 RF MODULATOR
ANTENNA SWITCH
VIDEO INTERFACE CHIP U19
L2
AUDIO/ VIDEO CN5
SERIAL I/O CN4
PROGRAM LOGIC ARRAY U17
SOUND INTERFACE DEVICE U18
MICROPROCESSOR U7
CASSETTE CN3
ROM U4
USER PORT CN2
COMPLEX INTERFACE ADAPTER U1 U2
CN1
KEYBOARD

# PRELIMINARY SERVICE CHECKS (Continued)

## DISASSEMBLY INSTRUCTIONS

### CABINET TOP REMOVAL

Remove three screws from cabinet bottom. Lift cabinet top and keyboard from cabinet bottom. Disconnect the keyboard connector and the power indicator connector from the main board.

### MAIN BOARD REMOVAL

Unsolder copper strip from the top, right side of the cardboard shield and carefully fold back shield. Remove the seven screws holding main board to cabinet bottom. Unsolder grounding strip at all nine places on the main board. Remove shield and main board from cabinet bottom.

### KEYBOARD REMOVAL

Remove eight screws holding the keyboard to cabinet top. Lift keyboard assembly from cabinet top.

CC4 COMMODORE MODEL 64

CC4 COMMODORE MODEL 64

## PRELIMINARY SERVICE CHECKS

ENCLOSED

## SAFETY PRECAUTIONS

See Page 4.

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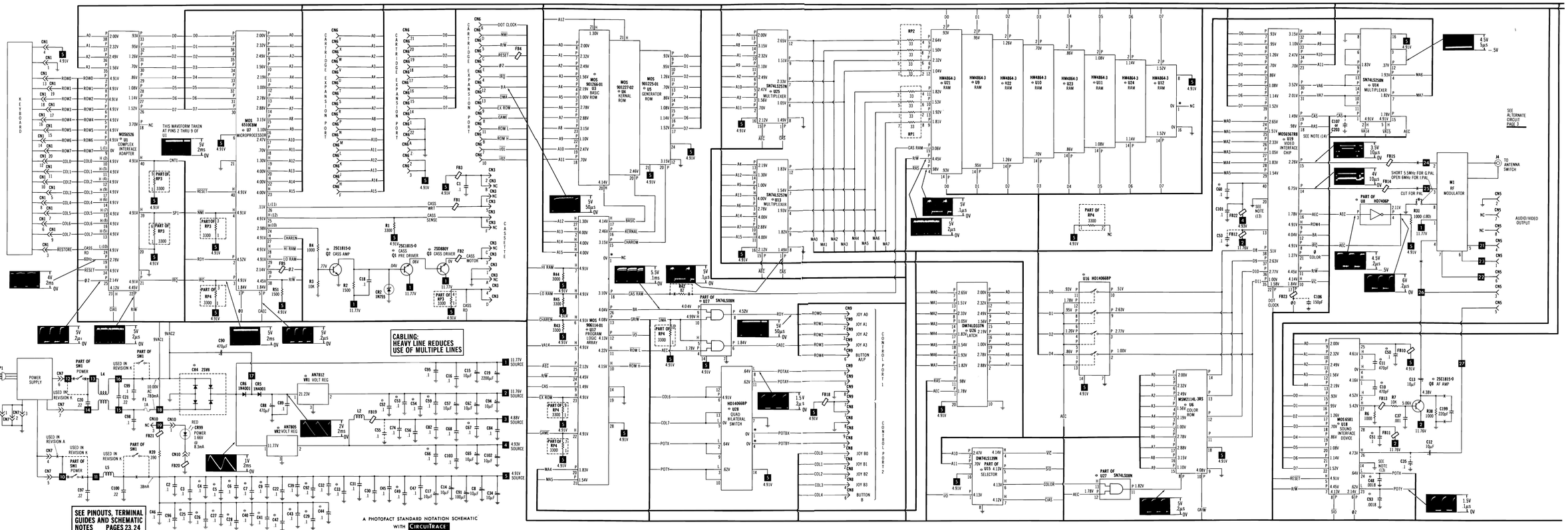
CABLING:
HEAVY LINE REDUCES
USE OF MULTIPLE LINES
SEE PINOUTS, TERMINAL GUIDES AND SCHEMATIC NOTES PAGES 23,24
SEE LINE DEFINITIONS ON PAGE 21
SEE ALTERNATE CIRCUIT PAGE 3
A PHOTOFACT STANDARD NOTATION SCHEMATIC WITH CIRCUITRACE
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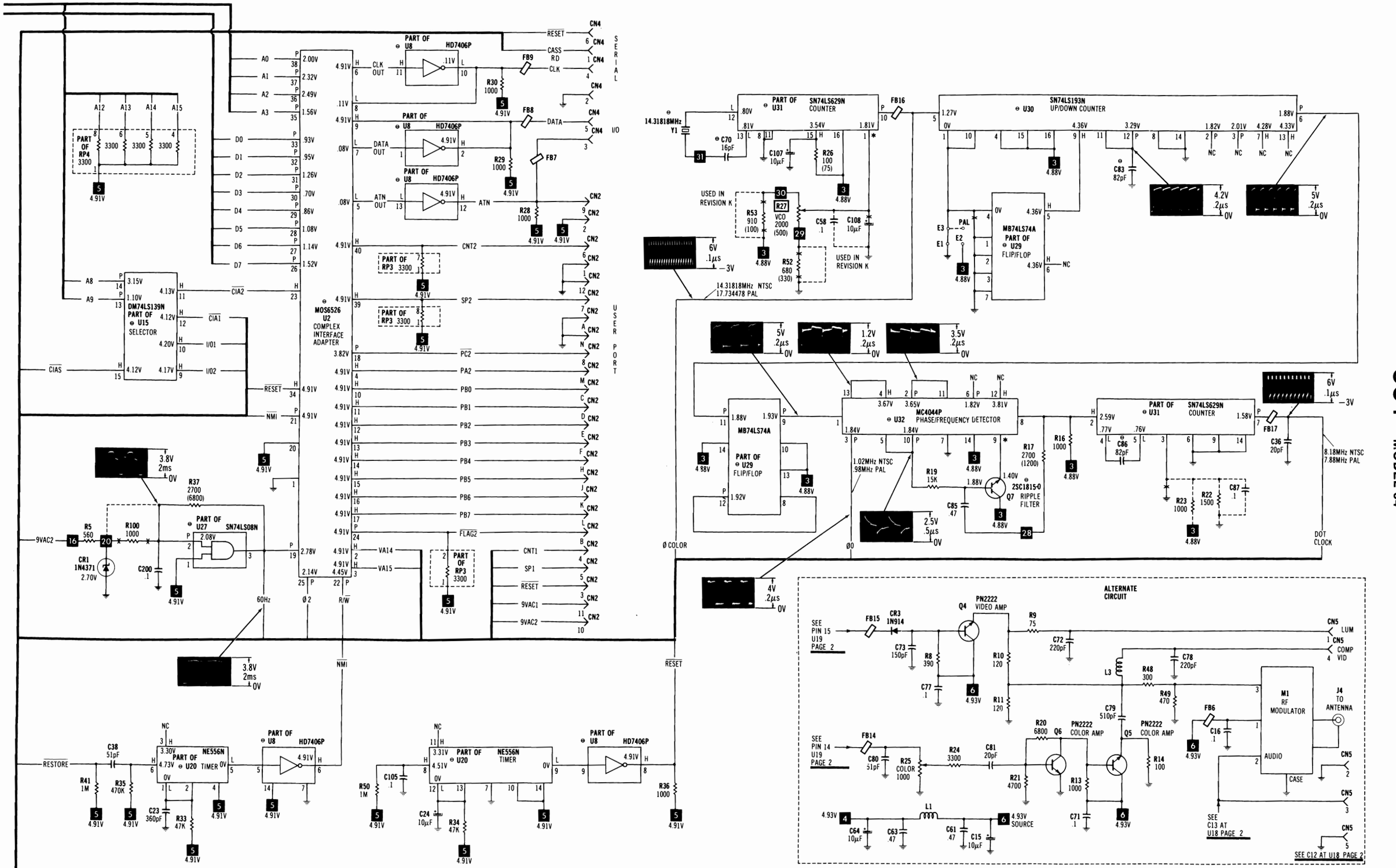


A PHOTOFACT STANDARD NOTATION SCHEMATIC WITH CIRCUITRACE®

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# GENERAL OPERATING INSTRUCTIONS

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### CASSETTE OPERATION

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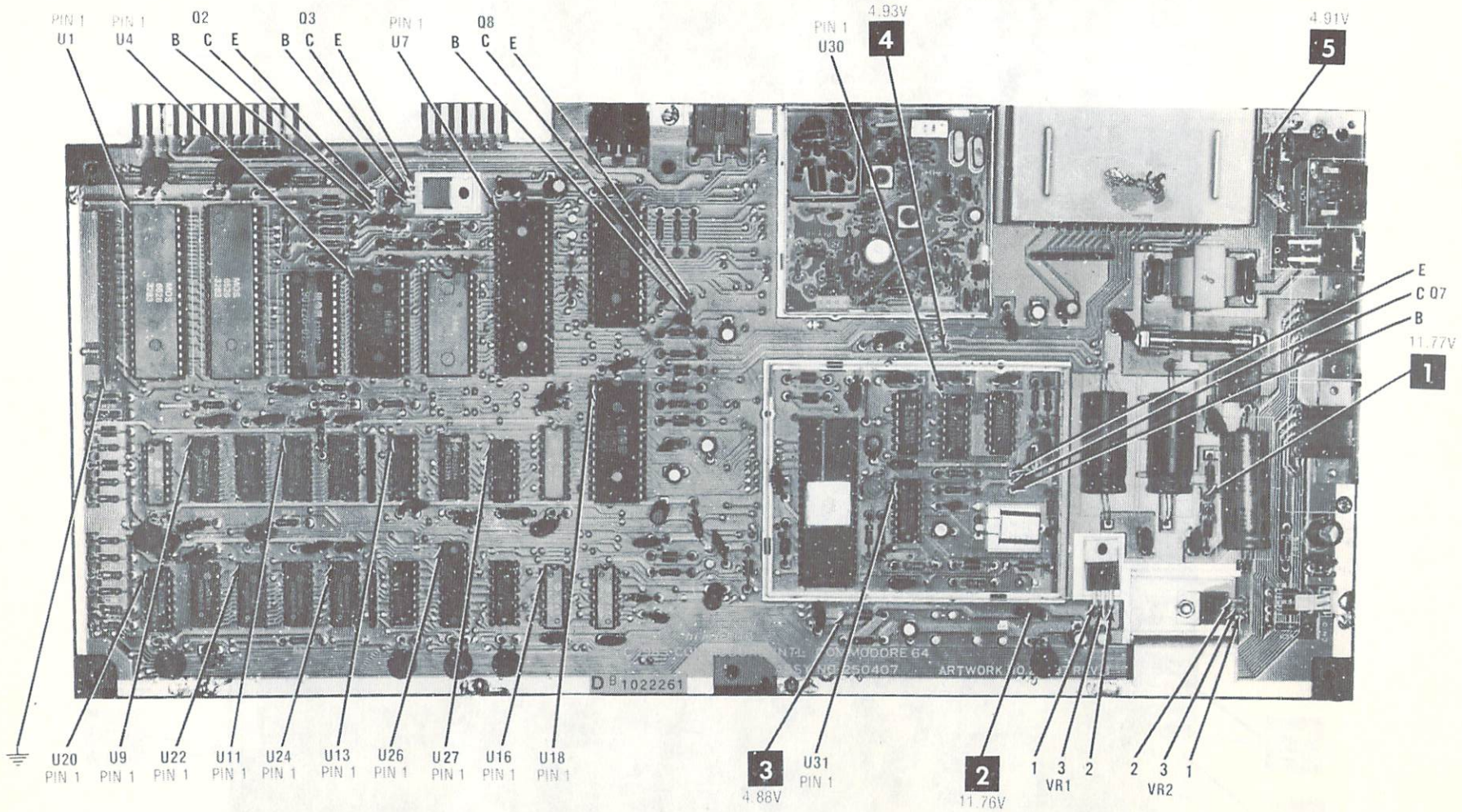
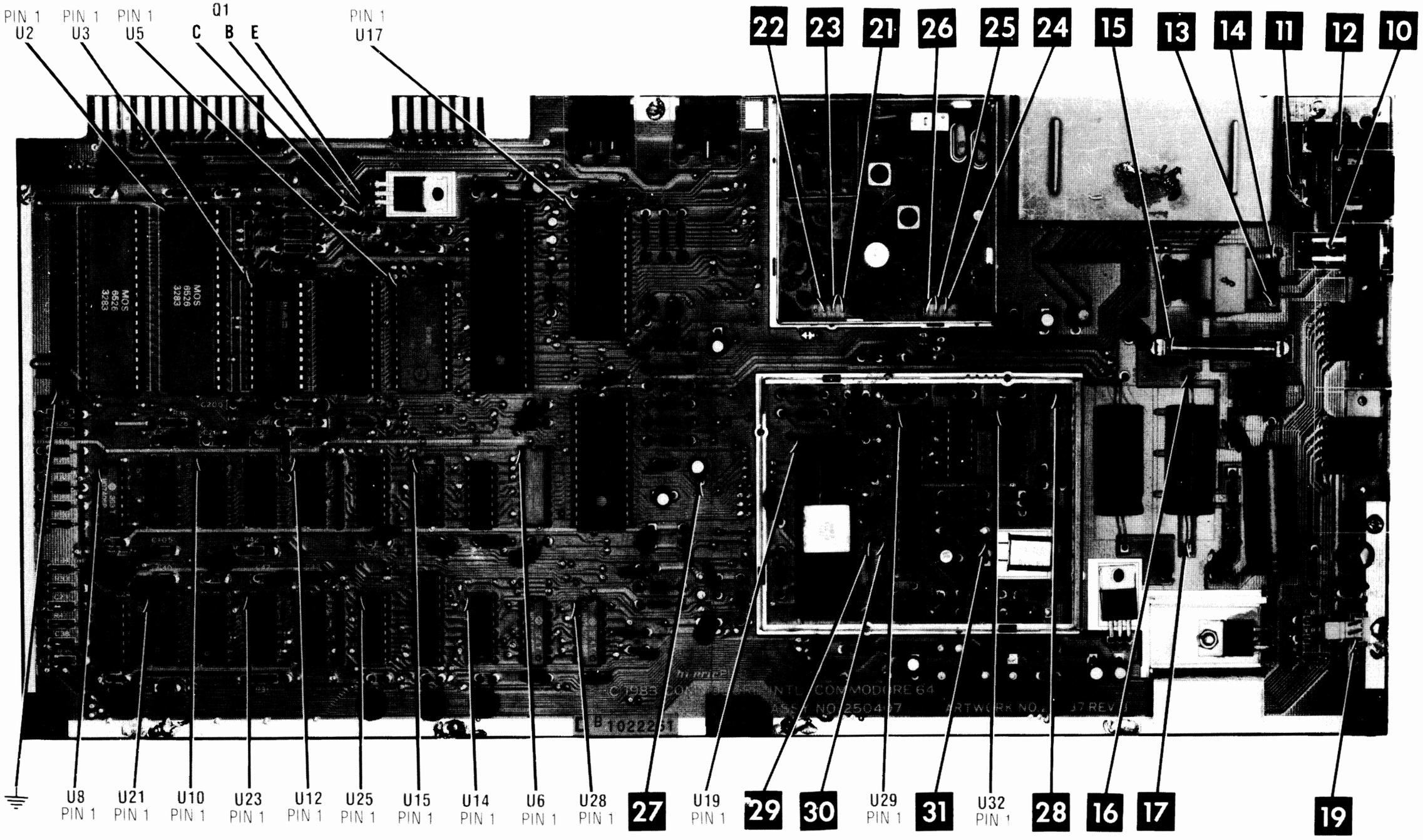
### DISK OPERATION

Connect Disk Drive unit to the Serial I/O Port (CN4) located at the rear of the computer. Carefully insert the disk so that the label on the disk is facing up and the notch on the disk is on the left side. Once the disk is inserted, close the protective gate by pushing down on the gate lever. To load a program from the disk, type LOAD "PROGRAM NAME", 8. Press the RETURN key and follow the instructions displayed on the monitor. To SAVE a program, type SAVE "PROGRAM NAME", 8 and press the RETURN key. NOTE: 8 is the code for the disk.

# SAFETY PRECAUTIONS

1. Use an isolation transformer for servicing.
2. Maintain AC line voltage at rated input.
3. Remove AC power from the computer before servicing or installing electrostatically sensitive devices. Examples of typical ES devices are integrated circuits and semiconductor "chip" components.
4. Use extreme caution when handling the printed circuit boards. Some semiconductor devices can be damaged easily by static electricity. Drain off any electrostatic charge on your body by touching a known earth ground. Wear a commercially available discharging wrist strap device. This should be removed prior to applying power to the unit under test.
5. Use a grounded-tip, low voltage soldering iron.
6. Use an isolation (times 10) probe on scope.
7. Do not remove or install boards, floppy disk drives, printers, or other peripherals with computer AC power On.
8. Do not use freon-propelled sprays. These can generate electrical charges sufficient to damage semiconductor devices.
9. This computer is equipped with a grounded three-pronged AC plug. This plug must fit into a grounded AC power outlet. Do not defeat the AC plug safety feature.
10. Periodically examine the AC power cord for damaged or cracked insulation.
11. The computer cabinet is equipped with vents to prevent heat build-up. Never block, cover, or obstruct these vents.
12. Instructions should be given, especially to children, that objects should not be dropped or pushed into the vents of the cabinet. This could cause shock or equipment damage.
13. Never expose the computer to water. If exposed to water, turn the unit off. Do not place the computer near possible water sources.
14. Never leave the computer unattended or plugged into the AC outlet for long periods of time. Remove AC plug from AC outlet during lightning storms.
15. Do not allow anything to rest on AC power cord.
16. Unplug AC power cord from outlet before cleaning computer.
17. Never use liquids or aerosols directly on the computer. Spray on cloth and then apply to the computer cabinet. Make sure the computer is disconnected from the AC power line.


PIN 1
U1
PIN 1
U4
Q2
B C E
Q3
B C E
PIN 1
U7
Q8
B C E
PIN 1
U30
4.93V
4
5
4.91V
E
C Q7
B
11.77V
1
U20
PIN 1
U9
PIN 1
U22
PIN 1
U11
PIN 1
U24
PIN 1
U13
PIN 1
U26
PIN 1
U27
PIN 1
U16
PIN 1
U18
PIN 1
3
4.88V
U31
PIN 1
2
11.76V
1 3 2
VR1
2 3 1
VR2


PIN 1
U2
PIN 1
U3
PIN 1
U5
Q1
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B
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PIN 1
U17
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U8
PIN 1
U21
PIN 1
U10
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U23
PIN 1
U12
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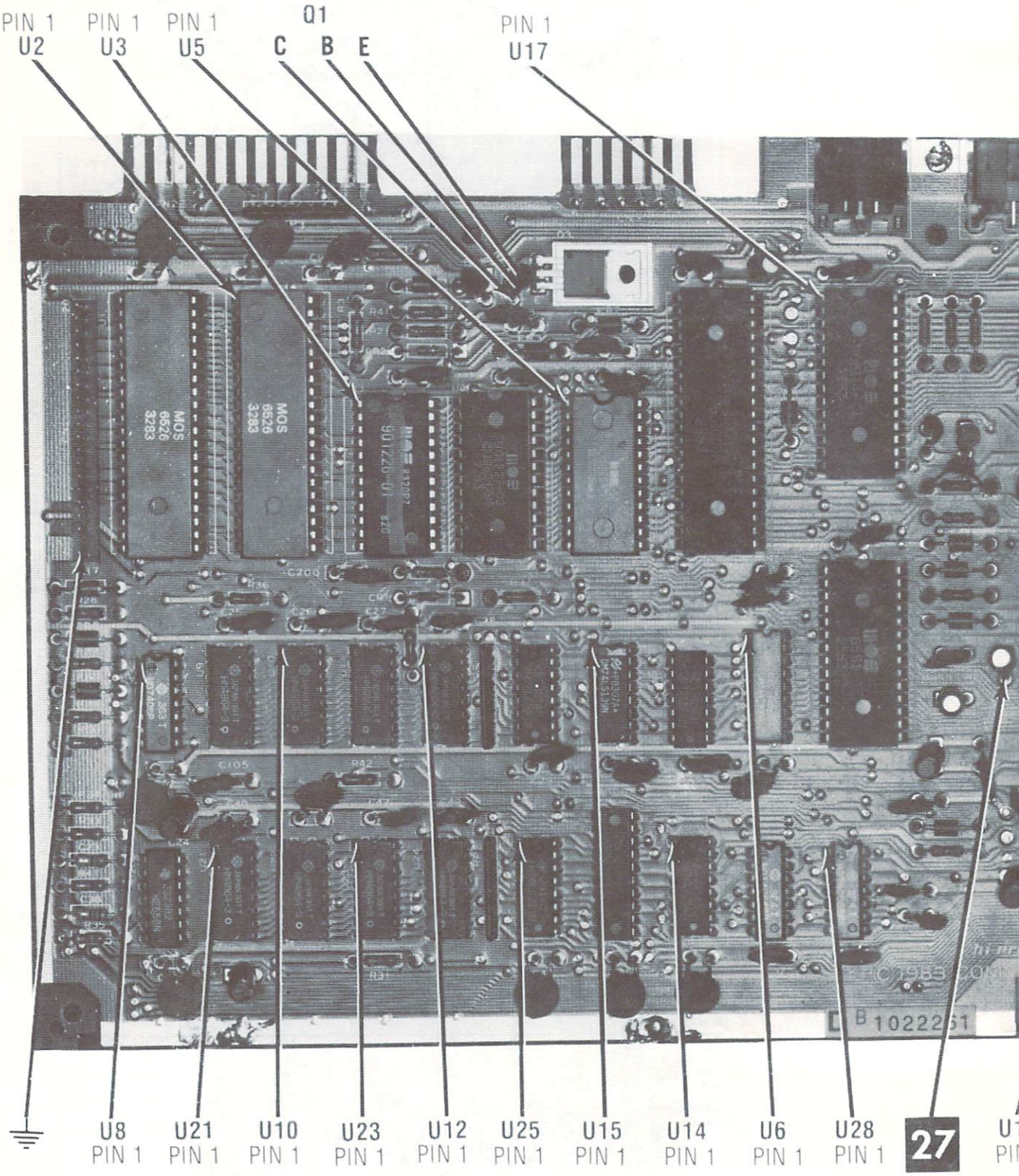
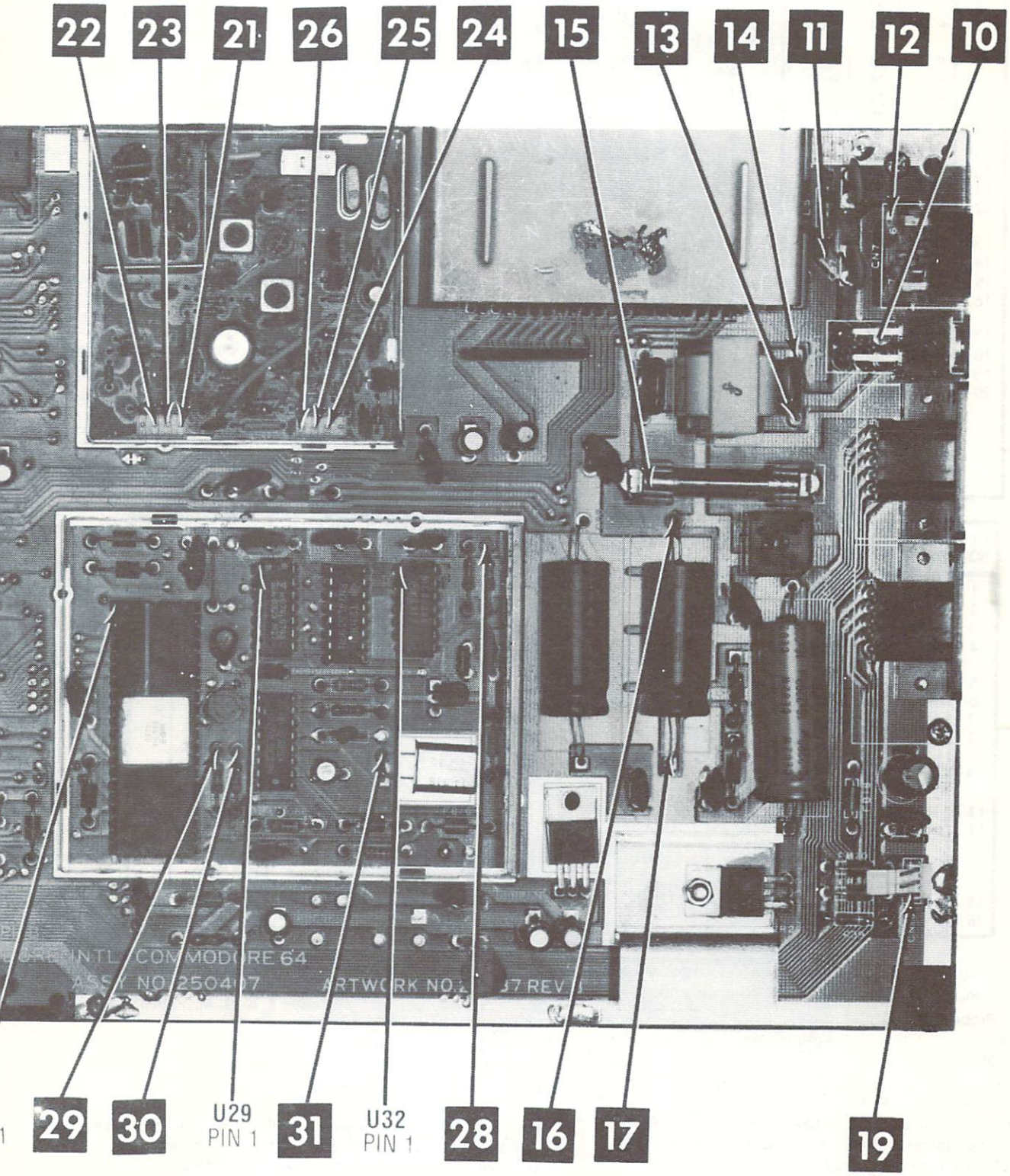



**MAIN BOARD** A Howard W. Sams CIRCUITRACE® Photo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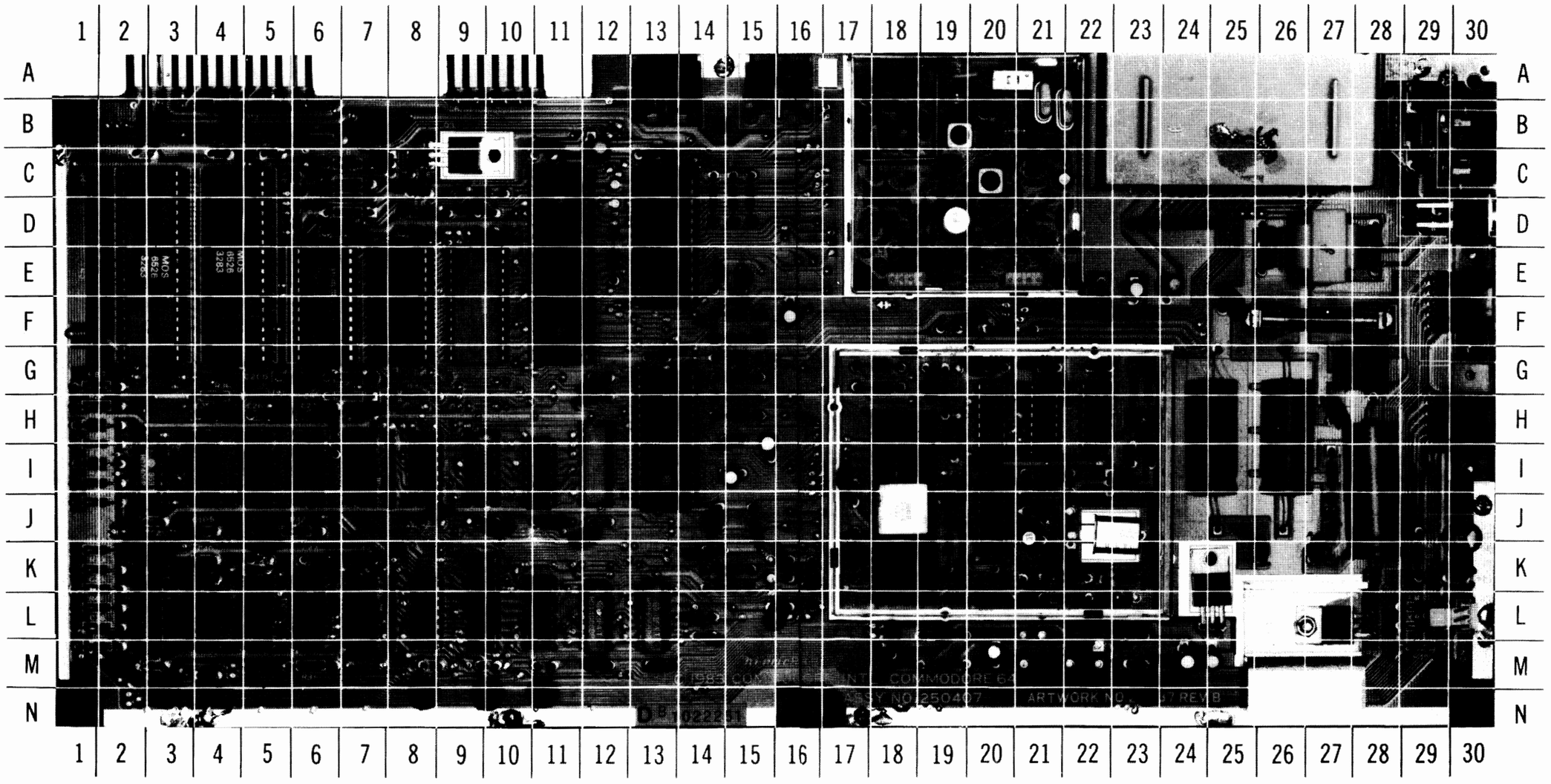
14
11
12
10
29
30
U29
PIN 1
31
U32
PIN 1
28
16
17
19

MAIN BOARD

## MAIN BOARD GridTrace LOCATION GUIDE

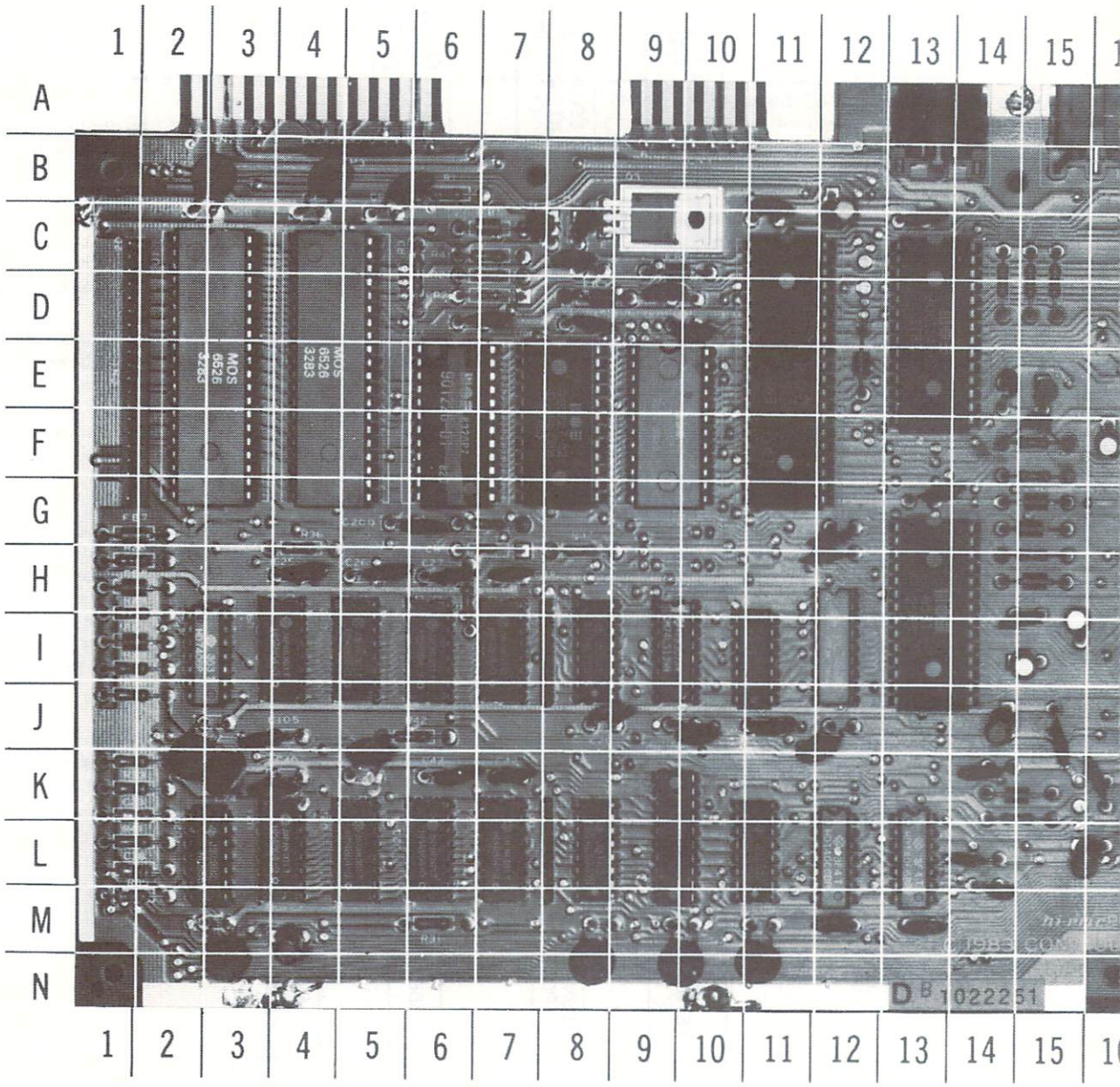
| | | | | | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| C1 | D-9 | C19 | I-28 | C38 | L-1 | C57 | M-25 | C91 | J-30 | CN1 | E-1 | L2 | M-19 | R26 | I-21 | R51 | K-15 | U13 | I-8 |
| C2 | B-3 | C20 | D-28 | C39 | N-3 | C59 | L-23 | C92 | K-30 | CN2 | A-4 | L4 | D-27 | R27 | J-19 | R52 | K-19 | U14 | L-11 |
| C3 | B-4 | C21 | E-26 | C40 | K-4 | C60 | F-20 | C93 | L-14 | CN3 | A-10 | L5 | B-28 | R28 | H-1 | R53 | K-19 | U15 | I-9 |
| C4 | D-7 | C22 | J-2 | C41 | K-5 | C62 | I-15 | C94 | L-16 | CN4 | A-13 | Q1 | C-8 | R29 | H-1 | R100 | H-6 | U16 | L-12 |
| C5 | D-8 | C23 | K-1 | C42 | K-6 | C65 | M-20 | C95 | K-27 | CN5 | A-16 | Q2 | C-7 | R30 | I-1 | RP3 | B-5 | U17 | D-13 |
| C6 | D-10 | C24 | K-3 | C43 | K-7 | C66 | L-20 | C96 | B-5 | CN6 | B-25 | Q3 | C-9 | R31 | M-6 | SW1 | D-30 | U18 | H-13 |
| C7 | J-12 | C25 | H-4 | C44 | N-8 | C67 | L-18 | C97 | C-29 | CN7 | B-30 | Q7 | I-23 | R33 | K-1 | U1 | E-3 | U19 | I-18 |
| C8 | B-12 | C26 | H-5 | C45 | N-10 | C68 | I-20 | C98 | F-25 | CN8 | F-30 | Q8 | E-15 | R34 | K-1 | U2 | E-4 | U20 | L-3 |
| C9 | B-11 | C27 | H-6 | C46 | J-11 | C70 | J-21 | C99 | H-27 | CN9 | H-30 | R1 | B-6 | R35 | M-1 | U3 | F-6 | U21 | L-4 |
| C10 | G-12 | C28 | H-7 | C47 | M-13 | C74 | G-21 | C100 | A-29 | CN10 | L-30 | R2 | D-7 | R36 | G-4 | U4 | F-8 | U22 | L-5 |
| C11 | H-12 | C29 | J-8 | C48 | M-14 | C82 | G-20 | C101 | G-19 | CR1 | G-7 | R3 | C-6 | R37 | G-8 | U5 | F-9 | U23 | L-6 |
| C12 | I-15 | C30 | M-11 | C49 | J-16 | C83 | I-21 | C102 | M-24 | CR2 | D-7 | R4 | C-7 | R38 | F-15 | U6 | I-12 | U24 | L-7 |
| C13 | F-16 | C31 | J-10 | C50 | K-14 | C84 | H-23 | C103 | M-23 | CR4 | G-8 | R5 | G-7 | R41 | L-1 | U7 | E-11 | U25 | L-18 |
| C14 | M-4 | C32 | M-12 | C51 | G-13 | C85 | I-23 | C105 | J-3 | CR5 | J-27 | R6 | G-15 | R42 | J-6 | U8 | I-3 | U26 | L-9 |
| C15 | E-3 | C33 | C-13 | C52 | H-15 | C86 | K-20 | C107 | J-21 | CR6 | I-27 | R7 | F-15 | R43 | C-15 | U9 | I-4 | U27 | I-11 |
| C16 | F-22 | C34 | J-14 | C53 | K-16 | C88 | H-25 | C108 | H-19 | F1 | F-27 | R16 | J-23 | R44 | C-14 | U10 | I-5 | U28 | L-13 |
| C17 | E-24 | C36 | L-22 | C54 | I-17 | C89 | K-26 | C199 | F-15 | J1 | F-18 | R17 | G-23 | R45 | C-15 | U11 | I-6 | U29 | H-20 |
| C18 | C-8 | C37 | G-14 | C56 | G-22 | C90 | H-26 | C200 | G-6 | J4 | A-18 | R19 | G-23 | R50 | J-1 | U12 | I-7 | U30 | H-21 |
| | | | | | | | | | | | | | | | | | | U31 | J-20 |
| | | | | | | | | | | | | | | | | | | U32 | H-22 |
| | | | | | | | | | | | | | | | | | | Y1 | J-23 |




A Howard W. Sams GRIDTRACE™ Photo

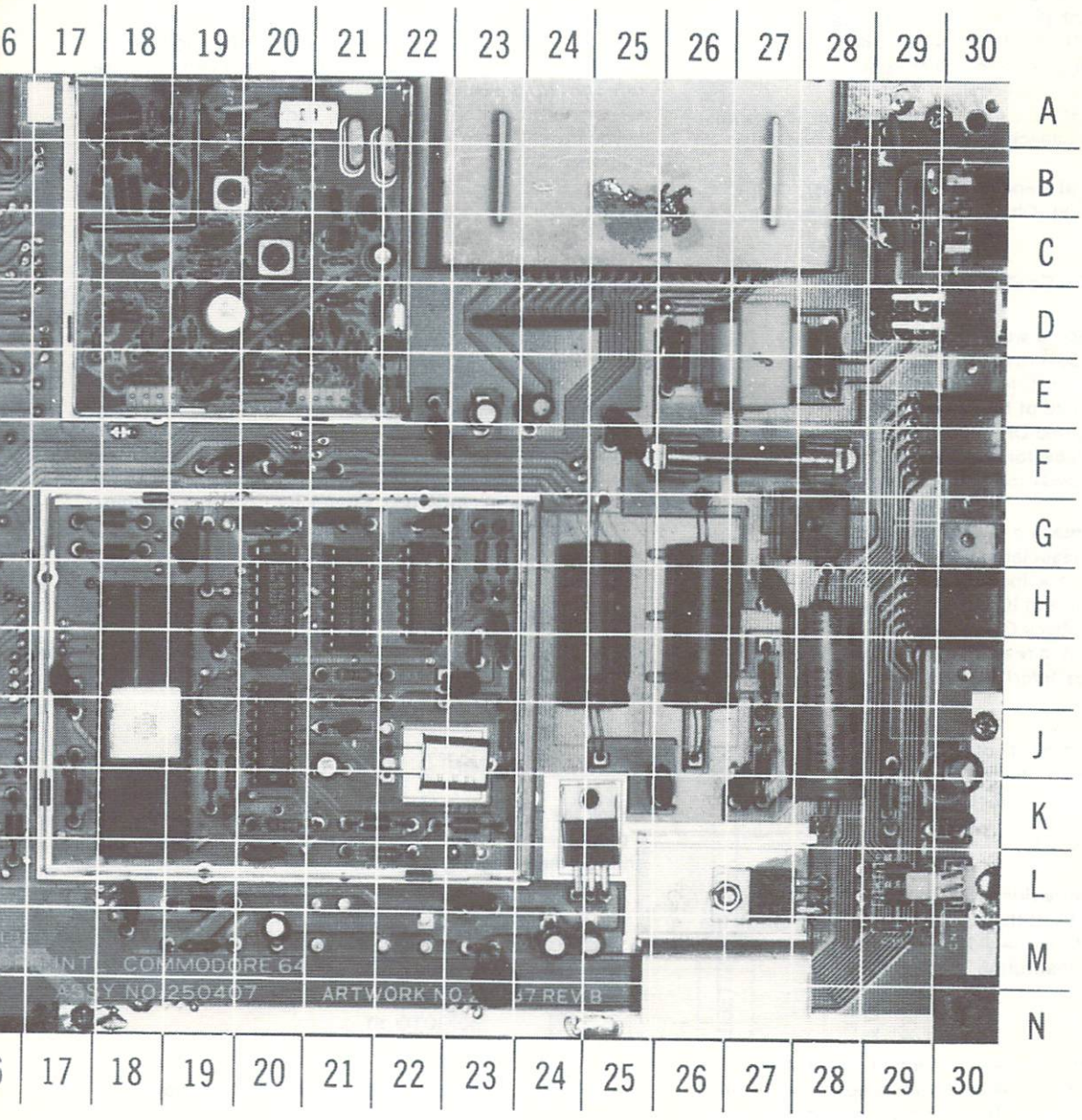
## MAIN BOARD GridTrace LOCATION GUIDE

| | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| C1 | D-9 | C19 | I-28 | C38 | L-1 | C57 | M-25 | C91 | J-30 | CN1 |
| C2 | B-3 | C20 | D-28 | C39 | N-3 | C59 | L-23 | C92 | K-30 | CN2 |
| C3 | B-4 | C21 | E-26 | C40 | K-4 | C60 | F-20 | C93 | L-14 | CN3 |
| C4 | D-7 | C22 | J-2 | C41 | K-5 | C62 | I-15 | C94 | L-16 | CN4 |
| C5 | D-8 | C23 | K-1 | C42 | K-6 | C65 | M-20 | C95 | K-27 | CN5 |
| C6 | D-10 | C24 | K-3 | C43 | K-7 | C66 | L-20 | C96 | B-5 | CN6 |
| C7 | J-12 | C25 | H-4 | C44 | N-8 | C67 | L-18 | C97 | C-29 | CN7 |
| C8 | B-12 | C26 | H-5 | C45 | N-10 | C68 | I-20 | C98 | F-25 | CN8 |
| C9 | B-11 | C27 | H-6 | C46 | J-11 | C70 | J-21 | C99 | H-27 | CN9 |
| C10 | G-12 | C28 | H-7 | C47 | M-13 | C74 | G-21 | C100 | A-29 | CN10 |
| C11 | H-12 | C29 | J-8 | C48 | M-14 | C82 | G-20 | C101 | G-19 | CR1 |
| C12 | I-15 | C30 | M-11 | C49 | J-16 | C83 | I-21 | C102 | M-24 | CR2 |
| C13 | F-16 | C31 | J-10 | C50 | K-14 | C84 | H-23 | C103 | M-23 | CR4 |
| C14 | M-4 | C32 | M-12 | C51 | G-13 | C85 | I-23 | C105 | J-3 | CR5 |
| C15 | E-3 | C33 | C-13 | C52 | H-15 | C86 | K-20 | C107 | J-21 | CR6 |
| C16 | F-22 | C34 | J-14 | C53 | K-16 | C88 | H-25 | C108 | H-19 | F1 |
| C17 | E-24 | C36 | L-22 | C54 | I-17 | C89 | K-26 | C199 | F-15 | J1 |
| C18 | C-8 | C37 | G-14 | C56 | G-22 | C90 | H-26 | C200 | G-6 | J4 |




**MAIN BOARD**

| | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| E-1 | L2 | M-19 | R26 | I-21 | R51 | K-15 | U13 | I-8 |
| A-4 | L4 | D-27 | R27 | J-19 | R52 | K-19 | U14 | L-11 |
| A-10 | L5 | B-28 | R28 | H-1 | R53 | K-19 | U15 | I-9 |
| A-13 | Q1 | C-8 | R29 | H-1 | R100 | H-6 | U16 | L-12 |
| A-16 | Q2 | C-7 | R30 | I-1 | RP3 | B-5 | U17 | D-13 |
| B-25 | Q3 | C-9 | R31 | M-6 | SW1 | D-30 | U18 | H-13 |
| B-30 | Q7 | I-23 | R33 | K-1 | U1 | E-3 | U19 | I-18 |
| F-30 | Q8 | E-15 | R34 | K-1 | U2 | E-4 | U20 | L-3 |
| H-30 | R1 | B-6 | R35 | M-1 | U3 | F-6 | U21 | L-4 |
| L-30 | R2 | D-7 | R36 | G-4 | U4 | F-8 | U22 | L-5 |
| G-7 | R3 | C-6 | R37 | G-8 | U5 | F-9 | U23 | L-6 |
| D-7 | R4 | C-7 | R38 | F-15 | U6 | I-12 | U24 | L-7 |
| G-8 | R5 | G-7 | R41 | L-1 | U7 | E-11 | U25 | L-18 |
| J-27 | R6 | G-15 | R42 | J-6 | U8 | I-3 | U26 | L-9 |
| I-27 | R7 | F-15 | R43 | C-15 | U9 | I-4 | U27 | I-11 |
| F-27 | R16 | J-23 | R44 | C-14 | U10 | I-5 | U28 | L-13 |
| F-18 | R17 | G-23 | R45 | C-15 | U11 | I-6 | U29 | H-20 |
| A-18 | R19 | G-23 | R50 | J-1 | U12 | I-7 | U30 | H-21 |
| | | | | | | | U31 | J-20 |
| | | | | | | | U32 | H-22 |
| | | | | | | | Y1 | J-23 |




A Howard W. Sams GRIDTRACE™ Photo

**MAIN BOARD**

# TROUBLESHOOTING

## POWER SUPPLY

The 11.77V source at anode of CR6 is missing. Check Fuse F1. If fuse has opened, check Bridge Rectifier CR4, Capacitors C19 and C95, and Voltage Regulator VR2 for shorts.

If fuse is good, check for 10.00VAC across Capacitor C21. Check Coil L4 by measuring for 10.00VAC at pins 6 and 7 of Power Input (CN7). Check Power Switch (SW1) and connections at CN7. Replace Power Supply if voltage is not obtained.

The 11.76V source at pin 2 of Voltage Regulator VR1 is missing. Check VR1, Diode CR5, Capacitors C88, C89 and C90. If all these check good, replace Power Supply.

The 4.91V source at positive (+) end of Capacitor C91 is missing. Check Coil L5 for open circuit. If Coil L5 is good, check Power Switch (SW1). Also, check the 5V at pin 5 of Power Input (CN7) and that the connections are good. Voltage still missing, replace Power Supply.

The 4.93V source at pin 2 of Voltage Regulator VR2 is missing. Check VR2, Capacitors C65, C66, C102 and C103.

The 4.88V source at Capacitors C55, C56, C67, C68, C74, C82 or C84 is missing. Check Coil L2 and Voltage Regulator VR2.

## MICROPROCESSOR CHIP (CPU) OPERATION

Verify the processor is working with a logic probe. Check for pulses on pins 30 thru 37, pins 7 thru 20, and pins 22 and 23 of Microprocessor IC (U7). If the Microprocessor is not working, check pin 40 of IC U7 with the logic probe, while the computer is turned OFF and back ON again. The logic probe should read Low for about two seconds after turn-on, then read High to reset the Microprocessor.

If the logic probe reading is not correct, check the voltages and components associated with the Timer IC (U20). If IC U20 is working, check for pulses on pin 3 of IC U7 and a High reading on pin 4 of IC U7. If the reading is not correct on pin 3 of IC U7, check Complex Interface Adapter IC (U1) by substitution. If the reading is not correct on pin 4 of IC U7, check Complex Interface Adapter IC (U2) by substitution.

Check for pulses on pin 38 of IC U7. Check for B+ voltage at pin 6 of IC U7. Also, check the voltages at pins 27, 28, and 29 of IC U7. Check for a clock waveform at pin 39 of IC U7.

## VIDEO

No video. Check for a video waveform at pin 15 of Video Interface Chip IC (U19). If the waveform is present, check the RF Modulator unit. If the video waveform is not present, check IC U19 by substitution.

## COLOR

No color. Check for a color waveform at pin 14 of Video Interface Chip IC (U19). If the waveform is not present, check IC U19 by substitution. If the colors are not correct, check the adjustment of the 14.31818 MHz Oscillator. See "Adjustment" section.

## AUDIO

No sound. Type in and run the program below. Check for an audio signal at pin 27 of Sound Interface Device IC (U18). If there is no audio signal present, check IC U18 by substitution. If an audio signal is present, check the voltages and components associated with Transistor Q8.

```
10 POKE 54296, 15
20 POKE 54278, 248
30 POKE 54273, 17
40 POKE 54276, 17
```

## KEYBOARD

Keyboard does not work. Check the waveforms at pins 2 thru 8 and pin 19 of Complex Interface Adapter IC (U1). If any of the waveforms are not present, check IC U1 by substitution. If the waveforms are present, check the operation of the keyboard by checking the logic probe readings on pins 9 thru 17 of IC U1. For readings that are not correct, check the keyboard Connector CN1, and the key switches on the keyboard for bad connections. If the keyboard still does not operate correctly, check IC U1 by substitution.

If the RESTORE key is not working, check for 0V on pin 3 of Connector CN1 when the RESTORE key is pressed. If the voltage does not drop to 0V, check for a bad connection at Connector CN1 and check the RESTORE key switch with an ohmmeter.

## JOYSTICK

Joystick does not work properly. Check the voltages on the pins shown in the chart below, while the appropriate joystick position is activated. The voltage should go from about 5V to less than 0.5V. If any voltage is not correct, check the joystick switches, Connector CN9, and Complex Interface Adapter IC (U1) by substitution.

| PORT 1 | | | PORT 2 | | |
|---|---|---|---|---|---|
| IC | PIN | JOYSTICK POSITION | IC | PIN | JOYSTICK POSITION |
| U1 | 10 | UP | U1 | 2 | UP |
| U1 | 11 | DOWN | U1 | 3 | DOWN |
| U1 | 12 | LEFT | U1 | 4 | LEFT |
| U1 | 13 | RIGHT | U1 | 5 | RIGHT |
| U1 | 14 | BUTTON | U1 | 6 | BUTTON |

Check the operation of the joystick by loading and running a program that uses the joystick or type into the computer and run the following program.

```
10 P1 = PEEK (56320)
20 P2 = PEEK (56321)
30 PRINT P1, P2
40 FOR T = 1 TO 400: NEXT T
50 GOTO 10
```

See chart for appropriate joystick ports and positions.

# TROUBLESHOOTING (Continued)

| JOYSTICK POSITION | PORT 1 | PORT 2 |
|---|---|---|
| CENTER | 255 | 127 |
| UP | 254 | 126 |
| DOWN | 253 | 125 |
| LEFT | 251 | 123 |
| RIGHT | 247 | 119 |
| BUTTON | 239 | 111 |

NOTE: OTHER NUMBERS WILL APPEAR IF TWO SWITCHES ON THE JOYSTICK ARE CLOSED AT THE SAME TIME.

### PADDLES

Buttons on the paddles do not work. Check the voltages on pins 12 and 13 of Complex Interface Adapter IC (U1) while using Control Port 1 and pins 4 and 5 of IC U1 while using Control Port 2. The voltage should go from 5V to 0V when the appropriate button is pressed. If the voltage does not change, check the button switches with an ohmmeter. Check Connectors CN9 (Control Port 1), and CN8 (Control Port 2) for bad connections. If the voltages check good, check IC U1 by substitution.

If the paddles do not work, check waveforms at pins 23 and 24 of Sound Interface Device IC (U18). If the waveforms are correct, check IC U18 by substitution. If the waveforms are not correct, check the paddle controls and connections with an ohmmeter. If the controls and connections are good, check Quad Bilateral Switch IC (U28) by substitution.

### CASSETTE SAVE AND LOAD

Computer will not save a program to a cassette tape. Check for pulses on pin 26 of Microprocessor IC (U7) with a logic probe, while saving a program to tape. If there are no pulses, check IC U7 by substitution. If the pulses are present, check the connections at pin 5 of Connector CN3.

Computer will not load a program from a cassette tape. Check for pulses on pin 24 of Complex Interface Adapter IC (U1) with a logic probe, while loading a program from tape. If the pulses are present, check IC U1 by substitution. If the pulses are not present, check the connections at pin 4 of Connector CN3.

Datassette cassette motor will not start when the recorder is put in Play or Record mode. Check the voltage at pin 25 of IC U7. The voltage on pin 25 should drop from 4.96V to .02V when the Datassette cassette recorder is in the Play or Record mode.

If the voltage does not change, check the connection at pin 6 of Connector CN3. If the voltage is correct, check the voltage at pin 24 of IC U7. The voltage on pin 24 should drop from 2.98V to .08V when the Datassette cassette recorder is put in the Play or Record mode. If the voltage is good, check the voltages and components associated with Transistors Q1 thru Q3.

See the voltage chart below for voltages with the recorder in Play or Record mode.

| | E | B | C |
|---|---|---|---|
| Q1 | 7.05V | 7.67V | 11.49V |
| Q2 | 0V | .07V | 7.67V |
| Q3 | 6.45V | 7.06V | 11.49V |

Note: Voltages taken with Datassette cassette recorder running.

# ADJUSTMENT

### 14 MHz OSCILLATOR

Connect the input of a frequency counter to pin 10 of IC (U31). Adjust R27 for a frequency of 14.31818 MHz at pin 10.

# PARTS LIST AND DESCRIPTION

When ordering parts, state Model, Part Number, and Description

## SEMICONDUCTORS (Select replacement for best results)

| ITEM No. | TYPE No. | MFGR. PART No. | REPLACEMENT DATA | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | ECG PART No. | GENERAL ELECTRIC PART No. | MOTOROLA PART No. | NTE PART No. | RCA PART No. | WORKMAN PART No. | ZENITH PART No. |
| CR1 | 1N4371 | 906103-02 | ECG5002A | | 1N5223B | NTE5002A | SK2A7/5002A | WEP1402/5002 | |
| CR2 | 1N755 | 900941-01 | ECG5015A | GEZD-7.5 | 1N5236B | NTE5015A | SK7A5/5015A | WEP1416/5015 | 103-Z9002 |
| CR3 | 1N914 | 900850-16 | ECG177 | GE-300 | 1N4935 | NTE177 | SK9091/177 | WEP1062/177 | 103-131 |
| CR4 | 2SVB | 251026 | ECG5312 | GE-5312 | MDA801 | NTE5312 | SK3985/5312 | WEP1065 | |
| | VM08 | 906129-01 | ECG5332 | | MDA920A7 | NTE5332 | SK9230 | | |
| CR5,6 | 1N4001 | 900750-01 | ECG116 | GE-504A | 1N4001 | NTE116 | SK3311 | WEP154 | 212-76-02 |
| Q1 | 2SC1815-0 | 902693-01 | ECG85 | GE-62 | MPSA05* | NTE85 | SK3124A/289A | WEP66/199 | 121-Z9065 |
| | 2N4401 | 902652-01 | ECG123AP | GE-123AP | MPSA05 | NTE123AP | SK3854/123AP | WEP736/123A | 121-Z9000A |
| Q2 | 2SC1815-0 | 902693-01 | ECG85 | GE-62 | MPSA05* | NTE85 | SK3124A/289A | WEP66/199 | 121-Z9065 |
| | 2N3904 | 902658-01 | ECG123AP | GE-123AP | MPSA05 | NTE123AP | SK3854/123AP | WEP736/123A | 121-Z9000A |
| Q3 | 2SD880Y | 902694-01 | ECG152 | GE-66A | TIP41A | NTE152 | SK3440/291 | WEP745/152 | 121-987-03 |
| | TIP29B | 902653-01 | ECG152 | GE-66A | TIP29B | NTE152 | SK3440/291 | WEP745/152 | 121-987-03 |
| Q4 | PN2222 | 902686-01(1) | ECG123AP | GE-123AP | MPSA05 | NTE123AP | SK3854/123AP | WEP736/123A | 121-Z9000A |
| Q5 | PN2222 | 902686-01(1) | ECG123AP | GE-123AP | MPSA05 | NTE123AP | SK3854/123AP | WEP736/123A | 121-Z9000A |
| Q6 | PN2222 | 902686-01(1) | ECG123AP | GE-123AP | MPSA05 | NTE123AP | SK3854/123AP | WEP736/123A | 121-Z9000A |
| Q7 | 2SC1815-0 | 902693-01 | ECG85 | GE-62 | MPSA05* | NTE85 | SK3124A/289A | WEP66/199 | 121-Z9065 |
| | PN2222A | 902686-01(1) | ECG123AP | GE-123AP | MPSA05 | NTE123AP | SK3854/123AP | WEP736/123A | 121-Z9000A |
| Q8 | 2SC1815-0 | 902693-01 | ECG85 | GE-62 | MPSA05* | NTE85 | SK3124A/289A | WEP66/199 | 121-Z9065 |
| | PN2222 | 902686-01(1) | ECG123AP | GE-123AP | MPSA05 | NTE123AP | SK3854/123AP | WEP736/123A | 121-Z9000A |
| U1,2 | MOS6526 | 906108-01 | | | | | | | |
| | 6526 | 906108-01 | | | | | | | |
| | 6526A | 906108-01 | | | | | | | |
| U3 | MOS901226-01 | 901226-01 | | | | | | | |
| | 2364A | 906144-01 (1)(3) | | | | | | | |
| | | 906141-01 (1)(2)(4) | | | | | | | |
| U4 | MOS901227-02 | 901227-02 (2)(4) | | | | | | | |
| | 2364A | 906145-02(3) | | | | | | | |
| | | 906145-01 (1)(3) | | | | | | | |

## PARTS LIST AND DESCRIPTION (Continued)

When ordering parts, state Model, Part Number, and Description

### SEMICONDUCTORS (Select replacement for best results) (cont)

| ITEM No. | TYPE No. | MFGR. PART No. | REPLACEMENT DATA | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | ECG PART No. | GENERAL ELECTRIC PART No. | MOTOROLA PART No. | NTE PART No. | RCA PART No. | WORKMAN PART No. | ZENITH PART No. |
| U5 | M0S901225-01 | 901225-01 (2)(4) | | | | | | | |
| | 2332A | 906140-01 (1)(2)(4) | | | | | | | |
| | | 906143-01 (1)(3) | | | | | | | |
| | 2332B | 901225-01 (2)(4) | | | | | | | |
| | | 906143-02(3) | | | | | | | |
| U6 | MSM2114L-3RS | | ECG2114 | | | NTE2114 | | | HE-443-764 |
| | 2114-30L | | ECG2114 | | | NTE2114 | | | HE-443-764 |
| | 2114L-30 | 901453-01 | | | | | | | |
| U7 | M0S6510CBM | | | | | | | | |
| | 6510A | 906107-01 | | | | | | | |
| U8 | HD7406P | | ECG7406 | GE-7406 | | NTE7406 | SK7406 | | HE-443-698 |
| | 7406N | | ECG7406 | GE-7406 | | NTE7406 | SK7406 | | HE-443-698 |
| | 7406 | 901522-06 | ECG7406 | GE-7406 | | NTE7406 | SK7406 | | HE-443-698 |
| U9 thru | HM4864-3 | | | | | | | | |
| U12 | 4164-2 | 901505-01(5) | | | | | | | |
| U13 | SN74LS257N | | ECG74LS257 | | SN74LS257AN | NTE74LS257 | SK74LS257 | | HE-443-802 |
| | 74LS257 | | ECG74LS257 | | SN74LS257AN | NTE74LS257 | SK74LS257 | | HE-443-802 |
| | 74LS257N | 901521-57 | ECG74LS257 | | SN74LS257AN | NTE74LS257 | SK74LS257 | | HE-443-802 |
| U14 | SN74LS258N | | ECG74LS258 | | SN74LS258AN | NTE74LS258 | SK74LS258 | | |
| | 74LS258 | | ECG74LS258 | | SN74LS258AN | NTE74LS258 | SK74LS258 | | |
| | 74LS258N | 901521-58 | ECG74LS258 | | SN74LS258AN | NTE74LS258 | SK74LS258 | | |
| U15 | DM74LS139N | | ECG74LS139 | | SN74LS139N | NTE74LS139 | | | |
| | 74LS139N | | ECG74LS139 | | SN74LS139N | NTE74LS139 | | | |
| | 74LS239 | 901521-18 | | | | | | | |
| U16 | HD14066BP | | ECG4066B | | MC14066BCP | NTE4066B | SK4066B | WEP4066B/4066B | 905-369 |
| | 4066 | | ECG4066B | | MC14066BCP | NTE4066B | SK4066B | WEP4066B/4066B | 905-369 |
| | | 901502-01 | | | | | | | |
| U17 | M0S906114-01 | | | | | | | | |
| | 82S100 | | | | | | | | |
| | 82S100N/ 7700 | 906114-01 (2)(3) | | | | | | | |
| | 93459 | 906114-06(4) | | | | | | | |
| | 82S100N | 906114-02 (1)(2)(3) | | | | | | | |
| | FPLA93459PC | 901337-01 (1)(4) | | | | | | | |

# PARTS LIST AND DESCRIPTION (Continued)

When ordering parts, state Model, Part Number, and Description

## SEMICONDUCTORS (Select replacement for best results) (cont)

| ITEM No. | TYPE No. | MFGR. PART No. | REPLACEMENT DATA | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | ECG PART No. | GENERAL ELECTRIC PART No. | MOTOROLA PART No. | NTE PART No. | RCA PART No. | WORKMAN PART No. | ZENITH PART No. |
| U18 | MOS6581 | | | | | | | | |
| | 6581 | 906112-01 | | | | | | | |
| U19 | MOS6567R8 | | | | | | | | |
| | 6567 | 906109-02 (2)(3) | | | | | | | |
| | 6569 | 906111-01(4) | | | | | | | |
| U20 | NE556N | | ECG978 | | MC3456P | NTE978 | SK3689/978 | | 221-Z9152 |
| | 556 | | ECG978 | | MC3456P | NTE978 | SK3689/978 | | 221-Z9152 |
| | NE556 | 901523-03 | ECG978 | | MC3456P | NTE978 | SK3689/978 | | 221-Z9152 |
| U21 thru | HM4864-3 | | | | | | | | |
| U24 | 4164-2 | 901505-01(5) | | | | | | | |
| U25 | SN74LS257N | | ECG74LS257 | | SN74LS257AN | NTE74LS257 | SK74LS257 | | HE-443-802 |
| | 74LS257 | | ECG74LS257 | | SN74LS257AN | NTE74LS257 | SK74LS257 | | HE-443-802 |
| | 74LS257N | 901521-57 | ECG74LS257 | | SN74LS257AN | NTE74LS257 | SK74LS257 | | HE-443-802 |
| U26 | DM74LS373N | | ECG74LS373 | | SN74LS373N | NTE74LS373 | | | HE-443-867 |
| | 74LS373 | | ECG74LS373 | | SN74LS373N | NTE74LS373 | | | HE-443-867 |
| | 74LS373N | 901521-29 | ECG74LS373 | | SN74LS373N | NTE74LS373 | | | HE-443-867 |
| U27 | SN74LS08N | | ECG74LS08 | | SN74LS08N | NTE74LS08 | SK74LS08 | | HE-443-780 |
| | 74LS08 | | ECG74LS08 | | SN74LS08N | NTE74LS08 | SK74LS08 | | HE-443-780 |
| | 74LS08N | 901521-03 | ECG74LS08 | | SN74LS08N | NTE74LS08 | SK74LS08 | | HE-443-780 |
| U28 | HD14066BP | | ECG4066B | | MC14066BCP | NTE4066B | SK4066B | WEP4066B/4066B | 905-369 |
| | 4066 | 901502-01 | ECG4066B | | MC14066BCP | NTE4066B | SK4066B | WEP4066B/4066B | 905-369 |
| U29 | MB74LS74A | | ECG74LS74A | | SN74LS74AN | NTE74LS74A | SK74LS74 | | HE-443-730 |
| | 74LS74 | | ECG74LS74A | | SN74LS74AN | NTE74LS74A | SK74LS74 | | HE-443-730 |
| | 74LS74AN | 901521-06 | ECG74LS74A | | SN74LS74AN | NTE74LS74A | SK74LS74 | | HE-443-730 |
| U30 | SN74LS193N | | ECG74LS193 | | SN74LS193N | NTE74LS193 | SK74LS193 | | HE-443-815 |
| | 74LS193 | | ECG74LS193 | | SN74LS193N | NTE74LS193 | SK74LS193 | | HE-443-815 |
| | 74LS193N | 901521-26 | ECG74LS193 | | SN74LS193N | NTE74LS193 | SK74LS193 | | HE-443-815 |
| U31 | SN74LS629N | | ECG74LS629 | | | NTE74LS629 | | | |
| | 74LS629N | 901521-68 | ECG74LS629 | | | NTE74LS629 | | | |
| U32 | MC4044P | | ECG974 | | MC4044P | | SK3965/974 | | |
| | MC4044 | | ECG974 | | MC4044P | | SK3965/974 | | |
| | MC4044CP | 906128-01 | ECG974 | | MC4044P | | SK3965/974 | | |

## PARTS LIST AND DESCRIPTION (Continued)

When ordering parts, state Model, Part No., and Description

## SEMICONDUCTORS (Select replacement for best results) (cont)

| ITEM No. | TYPE No. | MFGR. PART No. | REPLACEMENT DATA | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | ECG PART No. | GENERAL ELECTRIC PART No. | MOTOROLA PART No. | NTE PART No. | RCA PART No. | WORKMAN PART No. | ZENITH PART No. |
| VR1 | AN7812 | | ECG966 | GEVR-111 | MC7812CT | NTE966 | SK3592/966 | WEP966L/966 | HE-442-674 |
| | MD7812CT | | ECG966 | GEVR-111 | MC7812CT | NTE966 | SK3592/966 | WEP966L/966 | HE-442-674 |
| | MC7812CT | 901527-01 | ECG966 | GEVR-111 | MC7812CT | NTE966 | SK3592/966 | WEP966L/966 | HE-442-674 |
| VR2 | AN7805 | | ECG960 | GEVR-102 | MC7805CT | NTE960 | SK3591/960 | | 221-Z9043 |
| | 7805 | | ECG960 | GEVR-102 | MC7805CT | NTE960 | SK3591/960 | | 221-Z9043 |
| | MC7805CT | 901527-02 | ECG960 | GEVR-102 | MC7805CT | NTE960 | SK3591/960 | | 221-Z9043 |

Parts not noted are used in all applications.
* Lead configuration may vary from original.
(1) Revision N.
(2) NTSC or US version.
(3) JPN version.
(4) PAL version.
(5) Use only 901505-02 (150ns) Dynamic RAMs with U19 MOS6567 version R4. Do Not mix -01 with -02 RAMs on same P.C. Board.

## ELECTROLYTIC CAPACITORS

| ITEM No. | RATING | MFGR. PART No. |
|---|---|---|
| C8 | 10 50V 20% | |
| | 10 25V | 900100-01(1) |
| C12 | 10 50V 20% | |
| | 10 25V | 900100-01(1) |
| C13 | 10 50V 20% | |
| | 10 25V | 900100-01(1) |
| C14 | 10 50V 20% | |
| | 10 25V | 900100-01(1) |
| C15 | 10 50V 20% | |
| | 10 25V | 900100-01(1) |
| C17 | 10 50V 20% | |
| | 10 25V | 900100-01(1) |
| C19 | 2200 16V | 900101-33 |
| C24 | 10 50V 20% | |
| | 10 25V | 900100-01(1) |
| C34 | 10 50V 20% | |
| | 10 25V | 900100-01(1) |

| ITEM No. | RATING | MFGR. PART No. |
|---|---|---|
| C57 | 10 50V 20% | |
| | 10 25V | 900100-01(1) |
| C62 | 10 50V 20% | |
| | 10 25V | 900100-01(1) |
| C64 | 10 25V | 900100-01(1) |
| C65 | 10 50V 20% | |
| | 10 25V | 900100-01(1) |
| C88 | 470 50V 20% | 900101-34 |
| C90 | 470 50V 20% | 900101-34 |
| C91 | 100 16V | 900100-40 |
| C94 | 10 50V 20% | |
| | 10 25V | 900100-01(1) |
| C102 | 10 50V 20% | |
| | 10 25V | 900100-01(1) |
| C107 | 10 25V 20% | 251079-16(2) |
| C108 | 10 25V 20% | 251079-16(2) |

(1) May use 10uF @ 25V, 20%, Part No. 251079-16.
(2) Revision B.

## PARTS LIST AND DESCRIPTION (Continued)

When ordering parts, state Model, Part Number, and Description

## CAPACITORS

| ITEM No. | RATING | MFGR. PART No. |
|---|---|---|
| C1 | .1 25V | 251075-06 |
| | .1 | 900461-28 |
| C2 | .1 25V | 251075-06 |
| | .1 | 900461-28 |
| C3 | .1 25V | 251075-06 |
| | .1 | 900461-28 |
| C4 | .1 25V | 251075-06 |
| | .47 50V | 900464-36 |
| C5 | .1 25V | 251075-06 |
| | .1 | 900461-28 |
| | .47 50V | 900464-36 |
| C6 | .1 25V | 251075-06 |
| | .1 | 900461-28 |
| | .47 50V | 900464-36 |
| C7 | .1 25V | 251075-06 |
| | .1 | 900461-28 |
| | .47 50V | 900464-36 |
| C9 | .1 25V | 251075-06 |
| | .1 | 900461-28 |
| | .47 50V | 900464-36 |
| C10 | 470 50V 5% | 900462-53 |
| | 470 10% | 251069-4 |
| | 470 10% | 251078-39 |
| | .0022 | |
| C11 | 470 50V 5% | 900462-53 |
| | 470 10% | 251069-4 |
| | 470 10% | 251078-39 |
| | .0022 | |
| C16 | .1 25V | 251075-06 |
| | .1 | 900461-28 |
| C18 | .1 25V | 251075-06 |
| | .1 | 900461-28 |
| C20 | .22 100V 10% | |
| | .22 100V | 900150-11 |
| C21 | .22 100V 10% | |
| | .22 100V | 900150-11 |
| C22 | .1 25V | 251075-06 |
| | .1 | 900461-28 |
| C23 | 360 50V 10% | 251078-51 |
| | 360 50V | 900462-50 |
| C25 | .1 25V | 251075-06 |
| | .22 | 900461-32 |
| C26 | .1 25V | 251075-06 |
| | .22 | 900461-32 |
| C27 | .1 25V | 251075-06 |
| | .22 | 900461-32 |
| C28 | .1 25V | 251075-06 |
| | .22 | 900461-32 |
| C29 | .1 25V | 251075-06 |
| | .47 50V | 900464-36 |
| C30 | .1 25V | 251075-06 |
| | .1 | 900461-28 |
| C31 | .1 25V | 251075-06 |
| | .1 | 900461-28 |
| C32 | .1 25V | 251075-06 |
| | .1 | 900461-28 |
| C33 | .1 25V | 251075-06 |
| | .47 | 900464-36 |
| C35 | .1 | 900461-28 |
| C36 | 20 NPO 50V 5% | 251078-14 |
| | 20 50V | 900462-20 |
| C37 | .001 50V | 251069-8 |
| | .001 50V | 900462-61 |
| C38 | 51 N750 50V 5% | 251078-24 |
| | 51 50V | 900462-30 |
| C39 | .1 25V | 251075-06 |
| | .1 | 900461-28 |

| ITEM No. | RATING | MFGR. PART No. |
|---|---|---|
| C40 | .1 25V | 251075-06 |
| | .22 | 900461-32 |
| C41 | .1 25V | 251075-06 |
| | .22 | 900461-32 |
| C42 | .1 25V | 251075-06 |
| | .22 | 900461-32 |
| C43 | .1 25V | 251075-06 |
| | .22 | 900461-32 |
| C44 | .1 25V | 251075-06 |
| | .47 50V | 900464-36 |
| C45 | .1 25V | 251075-06 |
| | .1 | 900461-28 |
| C46 | .1 25V | 251075-06 |
| | .1 | 900461-28 |
| C47 | .1 25V | 251075-06 |
| | .1 | 900461-28 |
| C48 | .0018 50V 10% | 251069-11 |
| | .0018 10% | 251078-45 |
| | .0018 50V | 900462-67 |
| | .001 | |
| C49 | .1 25V | 251075-06 |
| | 470 50V | 900462-53 |
| | 470 10% | 251078-39 |
| C50 | .1 25V | 250175-06 |
| | .22 | 900461-32 |
| C51 | .1 25V | 250175-06 |
| | .47 | 900464-36 |
| C52 | .1 25V | 251075-06 |
| | 470 50V | 900462-53 |
| | 470 10% | 251078-39 |
| C53 | .1 25V | 251075-06 |
| | 470 50V | 900462-53 |
| | 470 10% | 251078-39 |
| C54 | .1 25V | 251075-06 |
| | .22 | 900461-32 |
| C55 | .1 | |
| | .1 | 900461-28 |
| C56 | .1 25V | 251075-06 |
| | .1 | 900461-28 |
| C58 | .1 | |
| | .1 | 900461-28 |
| C59 | .1 25V | 251075-06 |
| | .22 | 900461-32 |
| C60 | .1 25V | 251075-06 |
| | .47 50V | 900464-36 |
| C61 | .47 50V | 900464-36 |
| C63 | .47 50V | 900464-36 |
| C66 | .1 25V | 251075-06 |
| | .47 50V | 900464-36 |
| C67 | .1 25V | 251075-06 |
| | .47 50V | 900464-36 |
| C68 | .1 25V | 251075-06 |
| | .1 | 900461-28 |
| C70 | 16 50V | 251030-02 |
| | 10pF 50V 5% | 900050-14 |
| | 15 5% | 251030-01 |
| C71 | .1 | 900461-28 |
| C72 | 220 50V | 900462-45 |
| C73 | 150 50V | 900462-41 |
| C74 | .1 25V | 251075-06 |
| | .1 | 900461-28 |
| C77 | .1 | 900461-28 |
| C78 | 220 50V | 900462-45 |
| C79 | 510 | 900462-54 |
| C80 | 51 | 900462-30 |

## PARTS LIST AND DESCRIPTION (Continued)

When ordering parts, state Model, Part Number, and Description

### CAPACITORS (cont)

| ITEM No. | RATING | MFGR. PART No. |
|---|---|---|
| C81 | 20 | 900462-20 |
| C82 | .1 25V | 251075-06 |
| | .1 | 900461-28 |
| C83 | 82 50V 5% | 251078-29 |
| | 33 50V 5% | 900050-11 |
| C84 | .1 25V | 251075-06 |
| | .1 | 900461-28 |
| C85 | .47 50V | 900016-01 |
| | .47 50V | 900464-36 |
| C86 | 82 50V 5% | 251078-29 |
| | 39 50V 5% | 900050-17 |
| C87 | .1 | 900461-28 |
| C89 | .1 25V | 251075-06 |
| | .1 | 900461-28 |
| C92 | .1 25V | 251075-06 |
| | .22 | 900461-32 |
| C93 | .0018 50V 10% | 251069-11 |
| | .0018 10% | 251078-45 |
| | .0018 50V | 900462-67 |
| | .001 | |
| C95 | .1 25V | 251075-06 |
| | .1 | 900461-28 |

| ITEM No. | RATING | MFGR. PART No. |
|---|---|---|
| C96 | .1 25V | 251075-06 |
| | .1 | 900461-28 |
| C97 | .22 25V | 251075-07 |
| | .22 25V | 900010-59 |
| C98 | .1 50V | 251073-04 |
| | .1 50V | 900020-01 |
| C99 | .1 50V | 251073-04 |
| | .1 50V | 900020-01 |
| C100 | .22 25V | 251075-07 |
| | .22 25V | 900010-59 |
| C101 | .1 50V | 251073-04 |
| | .1 50V | 900020-01 |
| C103 | .1 25V | 251075-06 |
| | .1 | 900461-28 |
| C105 | .1 25V | 251075-06 |
| | .1 | 900461-28 |
| C106 | 150 50V | |
| C107 | 50 | (1) |
| | 220 10% | (2) |
| C199 | 220 50V 5% | |
| C200 | .1 25V | 251075-06 |
| C203 | 220 10% | (2) |

(1) Used with U19 (MOS6567 versions R4, R4T2).
(2) Used with U19 (MOS6569 version R1).

### CONTROLS (All wattages ½ watt, or less, unless listed)

| ITEM NO. | FUNCTION | RESISTANCE | MFGR. PART NO. | NOTES |
|---|---|---|---|---|
| R25 | Color | 1000 | 902265-02 | |
| | Color | 500 | 902265-05 | Revision B |
| R27 | VCC | 2000 | 902265-03 | |

### RESISTORS (Power and Special)

| ITEM No. | RATING | REPLACEMENT DATA | | |
|---|---|---|---|---|
| | | MFGR. PART No. | WORKMAN PART No. | REMARKS |
| RP1 | Resistor Network | 902422-03(1) | | |
| RP2 | Resistor Network | 902422-03(1) | | |
| RP3 | Resistor Network | 902442-29(2) | | |
| RP4 | Resistor Network | 902410-06(3) | | |

(1) Contains four (4) 33 5%
(2) Contains seven (7) 3300 5%
(3) Contains nine (9) 3300 5%

### COILS (RF-IF)

| ITEM No. | FUNCTION | MFGR. PART No. |
|---|---|---|
| L1 | RF Choke (2.2uH) | 901151-17 |
| L2 | RF Choke (2.2uH) | 901151-17 |
| L3 | Peaking (3.0uH) | 901151-21 |
| L4 | AC Line Choke | 325559-02 |

| ITEM No. | FUNCTION | MFGR. PART No. |
|---|---|---|
| L5 | AC Line Choke | 906127-01(1) |
| | RF Choke (1.2uH) | 325570-01 |
| | RF Choke (1.2uH) | 901152-01(1) |

(1) Revision N.

## PARTS LIST AND DESCRIPTION (Continued)

When ordering parts, state Model, Part Number, and Description

## FUSE DEVICES

| ITEM NO. | DESCRIPTION | MFGR. PART NO. | | NOTES |
|---|---|---|---|---|
| | | DEVICE | HOLDER | |
| F1 | 1A @ 250V Fast Acting<br>1.25A @ 250V Slow-Blow | 903556-18<br>251184-02 | 906102-01(1)<br>906102-01(1) | (1) Two used. |

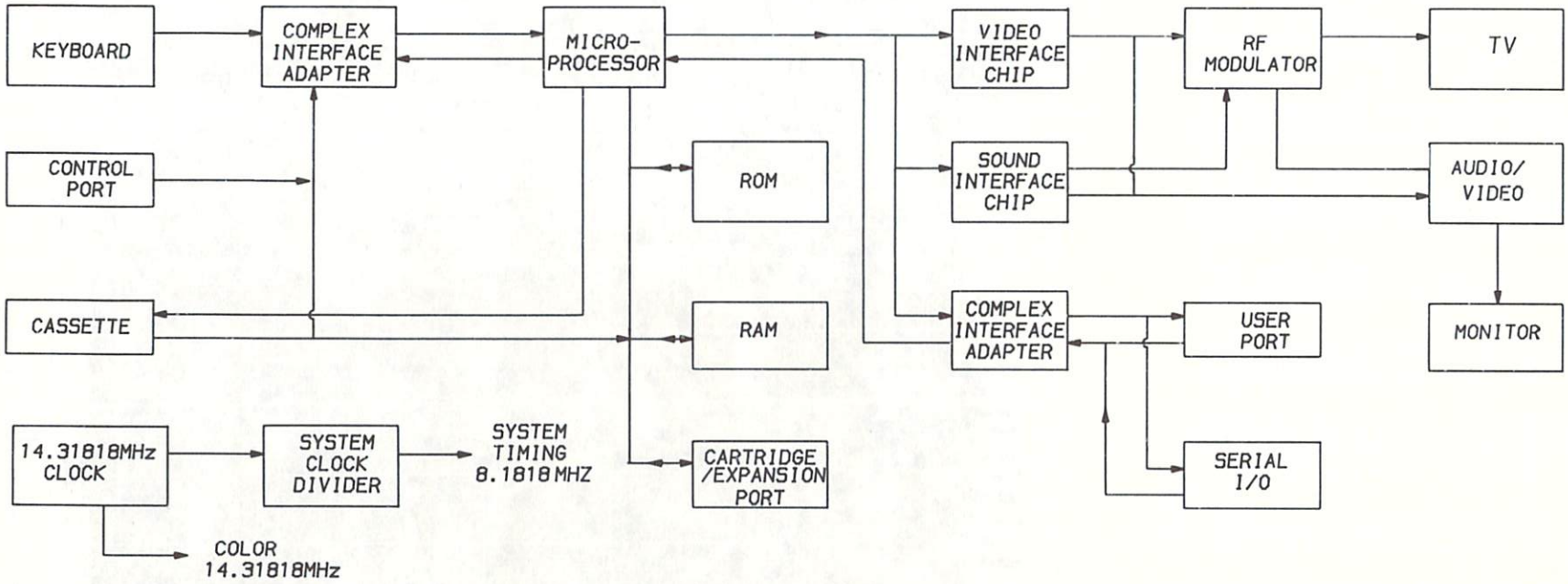
## MISCELLANEOUS

| ITEM No. | PART NAME | MFGR. PART No. | NOTES |
|---|---|---|---|
| CN1 | Connector | 903345-20 | 20 pin, male, Keyboard |
| | Connector | | 20 pin, male, Keyboard (Revision N) |
| CN4 | Connector | 903361-01 | 6 pin, female, Serial I/O |
| CN5 | Connector | | 8 pin, female, Audio/Video |
| | Connector | 903362-01 | 5 pin, female, Audio/Video (Revision N) |
| CN6 | Connector | 906100-02 | 44 pin, female, Cartridge Expansion Port |
| CN7 | Connector | | 7 pin, female, Power Input |
| | Connector | 906130-01 | 7 pin, female, Power Input (Revision N) |
| CN8,9 | Connector | | 9 pin, male, Control Port |
| | Connector | | 9 pin, male, Control Port (Revision N) |
| CN10 | Connector | 903302-13 | 3 pin, male, Power Indicator |
| | Connector | | 3 pin, male, Power Indicator (Revision N) |
| CR99 | LED | 980082 | Power Indicator, Red 1.66V @ 8.3mA |
| FB1 thru 5 | Ferrite Bead | 903025-01 | |
| FB7 thru 23 | Ferrite Bead | 903025-01 | |
| FB6 | Ferrite Bead | 903025-01 | (Revision N) |
| J4 | Jack | | RF Modulator |
| M1 | RF Modulator | 251080-01 | 8 pin (64) |
| | RF Modulator | 326130-01 | 5 pin (64) (Revision N) |
| | RF Modulator | 251019 | JIS version (Revision B) |
| | RF Modulator | 251025 | PAL version (Revision B) |
| P1 | Cord | 903508-04 | AC Power |
| SW1 | Switch | 904500-01 | Power On/Off |
| Y1 | Crystal | | 14.31818MHz |
| | Crystal | 900558-01 | 14.31818MHz (Revision N) |
| | Crystal | 251082 | 17.73447MHz, PAL version (Revision B) |
| | Crystal | 906106-01 | 17.73447MHz, PAL version (Revision N) |
| | Keyboard | 1001028-02 | |
| | P.C. Board | 250407-04 | 8 pin (Revision B) |
| | P.C. Board | 326298-01 | 5 pin |
| | Power Supply | 251053-02 | |

## CABINETS & CABINET PARTS (When ordering specify model, chassis & color)

## WIRING DATA

| | | |
|---|---|---|
| Shielded Hook-up Wire ..... | Use BELDEN No. | 8401 or 8421 (Single-Conductor)<br>8208 (Two-Conductor) |
| General-use Unshielded Hook-up Wire ..... | Use BELDEN No. | 8529 (Solid) Available in 13 Colors<br>8522 (Stranded) Available in 13 Colors |
| 300-Ohm Input Lead ..... | Use BELDEN No. | 8225 |
| 75-Ohm Input Lead ..... | Use BELDEN No. | 8241 |


KEYBOARD
COMPLEX INTERFACE ADAPTER
MICRO-PROCESSOR
VIDEO INTERFACE CHIP
RF MODULATOR
TV
CONTROL PORT
ROM
SOUND INTERFACE CHIP
AUDIO/ VIDEO
CASSETTE
RAM
COMPLEX INTERFACE ADAPTER
USER PORT
MONITOR
14.31818MHz CLOCK
SYSTEM CLOCK DIVIDER
SYSTEM TIMING 8.1818MHZ
CARTRIDGE /EXPANSION PORT
SERIAL I/O
COLOR 14.31818MHz

SEE PAGE 7

SEE PAGE 6

# LOGIC

| PIN NO. | IC U1 | PIN NO. | IC U1 | PIN NO. | IC U2 | PIN NO. | IC U2 | PIN NO. | IC U3 | IC U4 | IC U5 | IC U6 | PIN NO. | IC U7 | PIN NO. | IC U7 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | L | 21 | P | 1 | L | 21 | P | 1 | P | P | P | P | 1 | P | 21 | L |
| 2 | P | 22 | P | 2 | H | 22 | P | 2 | P | P | P | P | 2 | P | 22 | H |
| 3 | P | 23 | H | 3 | H | 23 | H | 3 | P | P | P | P | 3 | P | 23 | H |
| 4 | P | 24 | L(10) | 4 | H | 24 | P | 4 | P | P | P | P | 4 | H | 24 | H(10) |
| 5 | P | 25 | P | 5 | L | 25 | P | 5 | P | P | P | P | 5 | P | 25 | H(12) |
| 6 | P | 26 | P | 6 | H | 26 | P | 6 | P | P | P | P | 6 | H | 26 | L(11) |
| 7 | P | 27 | P | 7 | L | 27 | P | 7 | P | P | P | P | 7 | P | 27 | H |
| 8 | P | 28 | P | 8 | L | 28 | P | 8 | P | P | P | P | 8 | P | 28 | H |
| 9 | L(1) | 29 | P | 9 | H | 29 | P | 9 | P | P | P | L | 9 | P | 29 | H |
| 10 | H(2) | 30 | P | 10 | H | 30 | P | 10 | P | P | P | P | 10 | P | 30 | P |
| 11 | H(3) | 31 | P | 11 | H | 31 | P | 11 | P | P | P | P | 11 | P | 31 | P |
| 12 | H(4) | 32 | P | 12 | H | 32 | P | 12 | L | L | L | P | 12 | P | 32 | P |
| 13 | H(5) | 33 | P | 13 | H | 33 | P | 13 | P | P | P | P | 13 | P | 33 | P |
| 14 | H(6) | 34 | H | 14 | H | 34 | H | 14 | P | P | P | P | 14 | P | 34 | P |
| 15 | H(7) | 35 | P | 15 | H | 35 | P | 15 | P | P | P | P | 15 | P | 35 | P |
| 16 | H(8) | 36 | P | 16 | H | 36 | P | 16 | P | P | P | P | 16 | P | 36 | P |
| 17 | H(9) | 37 | P | 17 | H | 37 | P | 17 | P | P | P | P | 17 | P | 37 | P |
| 18 | P | 38 | P | 18 | P | 38 | P | 18 | P | P | P | H | 18 | P | 38 | P |
| 19 | P | 39 | H | 19 | P | 39 | H | 19 | P | P | P | | 19 | H | 39 | P |
| 20 | H | 40 | H | 20 | H | 40 | H | 20 | H | P | P | | 20 | H | 40 | H |
| | | | | | | | | 21 | H | H | H | | | | | |
| | | | | | | | | 22 | P | P | P | | | | | |
| | | | | | | | | 23 | P | P | P | | | | | |
| | | | | | | | | 24 | H | H | H | | | | | |

| PIN NO. | IC U8 | IC U9 | IC U10 | IC U11 | IC U12 | IC U13 | IC U14 | IC U15 | IC U16 | PIN NO. | IC U17 | PIN NO. | IC U17 | PIN NO. | IC U18 | PIN NO. | IC U18 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | L | * | * | * | * | P | P | P | P | 1 | * | 15 | P | 1 | H | 15 | P |
| 2 | H | P | P | P | P | H | H | P | P | 2 | H | 16 | P | 2 | H | 16 | P |
| 3 | P | P | P | P | P | P | P | P | P | 3 | H | 17 | H | 3 | H | 17 | P |
| 4 | P | P | P | P | P | P | P | H | P | 4 | H | 18 | P | 4 | H | 18 | P |
| 5 | L | P | P | P | P | H | H | P | P | 5 | H | 19 | L | 5 | H | 19 | P |
| 6 | H | P | P | P | P | P | P | H | P | 6 | H | 20 | P | 6 | P | 20 | P |
| 7 | L | P | P | P | P | P | P | H | L | 7 | H | 21 | P | 7 | P | 21 | P |
| 8 | H | H | H | H | H | L | L | L | P | 8 | H | 22 | H | 8 | P | 22 | P |
| 9 | L | P | P | P | P | P | P | H | P | 9 | P | 23 | H | 9 | P | 23 | L |
| 10 | L | P | P | P | P | P | P | H | P | 10 | H | 24 | P | 10 | P | 24 | L |
| 11 | H | P | P | P | P | H | P | H | P | 11 | H | 25 | P | 11 | P | 25 | H |
| 12 | H | P | P | P | P | P | P | H | P | 12 | P | 26 | P | 12 | P | 26 | H |
| 13 | L | P | P | P | P | P | P | P | P | 13 | P | 27 | H | 13 | P | 27 | H |
| 14 | H | P | P | P | P | H | P | P | H | 14 | L | 28 | H | 14 | L | 28 | H |
| 15 | | P | P | P | P | P | P | H | | | | | | | | | |
| 16 | | L | L | L | L | H | H | H | | | | | | | | | |

NOTE: Logic probe readings taken with computer turned On, no keys pressed, unless otherwise noted.

Logic Probe Display
L = Low
H = High
P = Pulse
* = Open (No lights On)

(1) Probe indicates P when any key is pressed.
(2) Probe indicates P when keys 1, 3, 5, 7, 9, +, &, INST DEL are pressed.
(3) Probe indicates P when keys ←, W, R, Y, I, P, *, RETURN are pressed.
(4) Probe indicates P when keys CTRL, A, D, G, J, L, ], CRSR→ are pressed.
(5) Probe indicates P when keys 2, 4, 6, 8, 0, -, CLR/HOME, F7 are pressed.
(6) Probe indicates P when keys Z, C, B, M, >, SHIFT (R), SPACE BAR, F1 are pressed.
(7) Probe indicates P when keys S, F, H, K, [, =, ⬛, F3 are pressed.
(8) Probe indicates P when keys Q, E, T, U, O, @, ↑, F5 are pressed.
(9) Probe indicates P when keys RUN/STOP, SHIFT LOCK, SHIFT (L), X, V, N, <, ?, ↑CRSR↓ are pressed.
(10) Probe indicates P during LOAD and SAVE.
(11) Probe indicates P during SAVE.
(12) Probe indicates L when PLAY or RECORD key is pressed.

## LOGIC (Continued)

| PIN NO. | IC U19 | PIN NO. | IC U19 | PIN NO. | IC U20 | IC U21 | IC U22 | IC U23 | IC U24 | IC U25 | IC U26 | IC U27 | IC U28 | IC U29 | IC U30 | IC U31 | IC U32 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | P | 21 | P | 1 | L | * | * | * | * | P | P | H | * | L | L | * | P |
| 2 | P | 22 | P | 2 | L | P | P | P | P | P | P | P | L | L | P | H | P |
| 3 | P | 23 | P | 3 | H | P | P | P | P | P | P | P | L | L | P | L | P |
| 4 | P | 24 | P | 4 | H | P | P | P | P | P | P | P | * | L | H | L | H |
| 5 | P | 25 | P | 5 | L | P | P | P | P | P | P | H | L | H | P | L | P |
| 6 | P | 26 | P | 6 | H | P | P | P | P | P | P | P | P | H | P | L | P |
| 7 | P | 27 | P | 7 | L | P | P | P | P | P | P | L | L | L | H | P | L |
| 8 | P | 28 | P | 8 | H | H | H | H | H | L | P | P | L | P | L | L | H |
| 9 | H | 29 | P | 9 | L | P | P | P | P | P | P | P | L | P | H | L | * |
| 10 | H | 30 | P | 10 | H | P | P | P | P | P | L | H | L | H | L | P | P |
| 11 | P | 31 | P | 11 | H | P | P | P | P | P | P | P | L | P | P | L | P |
| 12 | P | 32 | P | 12 | L | P | P | P | P | P | P | P | P | P | P | L | H |
| 13 | H | 33 | P | 13 | L | P | P | P | P | P | P | H | L | H | H | L | H |
| 14 | P | 34 | P | 14 | H | P | P | P | P | P | P | H | H | H | L | L | H |
| 15 | P | 35 | P | 15 | | P | P | P | P | P | P | | | | H | H | |
| 16 | P | 36 | P | 16 | | L | L | L | L | H | P | | | | H | H | |
| 17 | P | 37 | P | | | | | | | | P | | | | | | |
| 18 | P | 38 | P | | | | | | | | P | | | | | | |
| 19 | P | 39 | P | | | | | | | | P | | | | | | |
| 20 | L | 40 | H | | | | | | | | H | | | | | | |

NOTE: Logic probe readings taken with computer turned On, no keys pressed, unless otherwise noted.

Logic Probe Display
L = Low
H = High
P = Pulse
* = Open (No lights On)

## LINE DEFINITIONS

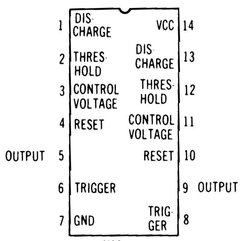
**A0-A15** ..... Address Lines
**AEC** ..... Address Enable Control
**ATN** ..... Attention
**BA** ..... Bus Available
**BASIC** ..... Basic Interpreter Line
**BUTTON A/LP** ..... Control Port A Firebutton /Light Pen Connection
**BUTTON B** ..... Control Port B Firebutton Connection
**CAS** ..... Column Address Strobe
**CAS RAM** ..... Column Address Strobe RAM
**CASS RD** ..... Cassette Read
**CASS SENSE** ..... Cassette Sensor
**CASS WRT** ..... Cassette Write
**CHAREN** ..... Character Generator ROM Control Line
**CHAROM** ..... Character Generator ROM Control Line
**CIA** ..... Complex Interface Adapter
**CIAS** ..... Complex Interface Adapter Select
**CLK** ..... Clock
**CNT** ..... Counter
**COL0-COL7** ..... Column Address Lines
**COLOR** ..... System Color
**CS** ..... Chip Select
**D0-D7** ..... Data Lines
**DATA** ..... Serial Bus Data Line
**DMA** ..... Direct Memory Access
**DOT CLOCK** ..... System Timing
**EX ROM** ..... External ROM
**FLAG2** ..... PC Data Transfer Control
**GAME** ..... Game I/O Line
**GR/W** ..... Graphics Read/Write
**HI RAM** ..... Kernal ROM Control Line
**I/O** ..... Input/Output
**IRQ** ..... Interrupt Request
**JOYA0-A3** ..... Control Port 1 Joystick Connections
**JOYB0-B3** ..... Control Port 2 Joystick Connections
**KERNAL** ..... Kernal ROM Control Line
**LO RAM** ..... Basic ROM Control Line
**LP** ..... Light Pen
**MA0-MA7** ..... Multiplex Address Lines
**NMI** ..... Non-Maskable Interrupt
**PA0-PA7** ..... User Port I/O Lines
**PB0-PB7** ..... User Port I/O Lines
**PC2** ..... User Port I/O Line
**PLA** ..... Program Logic Array
**POTAX** ..... Port 1 Potentiometer X
**POTAY** ..... Port 1 Potentiometer Y
**POTBX** ..... Port 2 Potentiometer X
**POTBY** ..... Port 2 Potentiometer Y
**POTX,Y** ..... Potentiometer X,Y
**R/W** ..... Read/Write
**RAS** ..... Row Address Strobe
**RDY** ..... Ready
**RESET** ..... Reset Computer
**RESTORE** ..... Pointer Reset to First Data Constant
**ROM L** ..... Active Low Decoded RAM/ROM Block Line
**ROM H** ..... Buffered Decoded RAM/ROM Block Line
**ROW0-ROW7** ..... Row Address Lines
**SID** ..... Sound Interface Device
**SP1,2** ..... Serial Port 1,2
**VA6,7,14,15** ..... Video Address Lines
**VIC** ..... Video Interface Chip
**Ø COLOR** ..... Phase Color
**Ø 0** ..... Phase 0
**Ø 2** ..... Phase Two
**9 VAC 1,2** ..... 60Hz Supply
**60Hz** ..... Time of Day Clock Sync

Any Bar above any alphabetical or numerical combination indicates line active in a low (0) state.

SEE PAGE 3

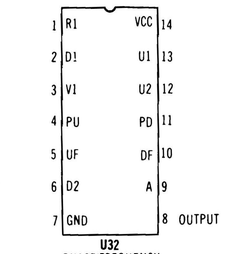
# IC PINOUTS, TERMINAL GUIDES & SCHEMATIC NOTES

**NE556N**



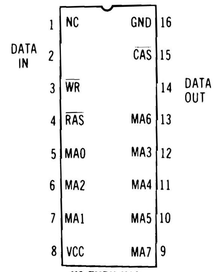

U20
TIMER
TOP VIEW

**MC4044P**



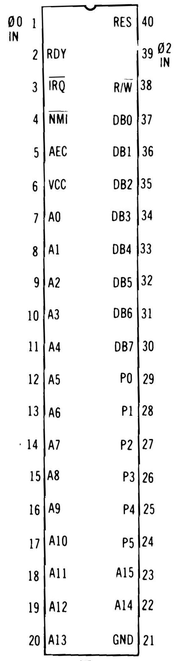

U32
PHASE/FREQUENCY DETECTOR
TOP VIEW

**HM4864-3**



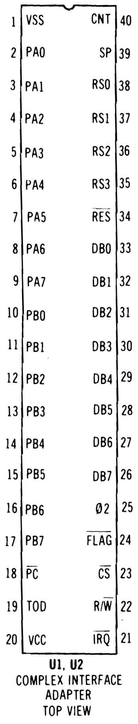

U9 THRU U12
U21 THRU U24
RAM
TOP VIEW

**MOS6510CBM**



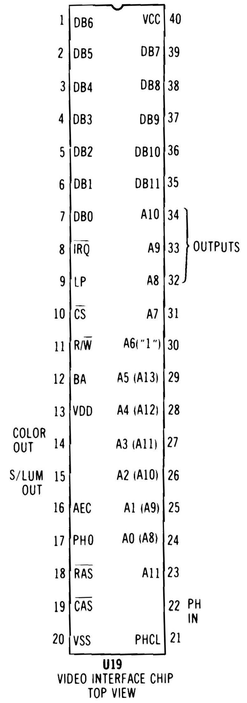

U7
MICROPROCESSOR
TOP VIEW

**MOS6526**



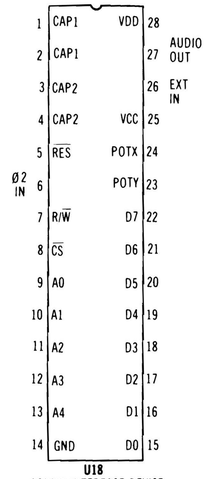

U1, U2
COMPLEX INTERFACE ADAPTER
TOP VIEW

**MOS6567R8**



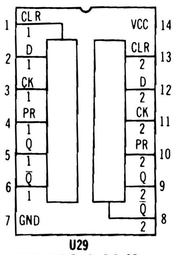

U19
VIDEO INTERFACE CHIP
TOP VIEW

**MOS6581**



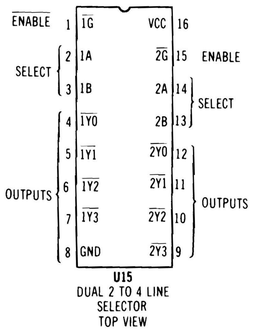

U18
SOUND INTERFACE DEVICE
TOP VIEW

**MB74LS74A**



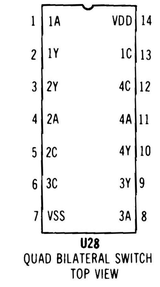

U29
DUAL D TYPE FLIP/FLOP WITH PRESET AND CLEAR
TOP VIEW

**DM74LS139N**



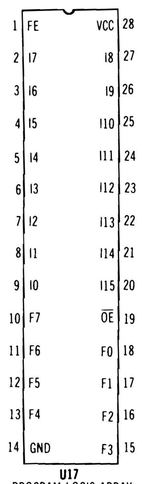

U15
DUAL 2 TO 4 LINE SELECTOR
TOP VIEW

**HD14066**



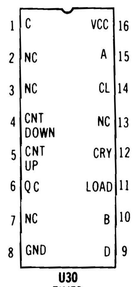

U28
QUAD BILATERAL SWITCH
TOP VIEW

**MDS906114-01**



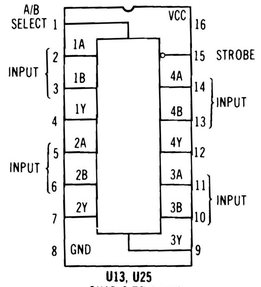

U17
PROGRAM LOGIC ARRAY
TOP VIEW

**SN74LS193N**



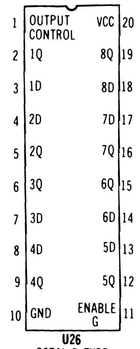

U30
TIMER
TOP VIEW

**SN74LS257N**



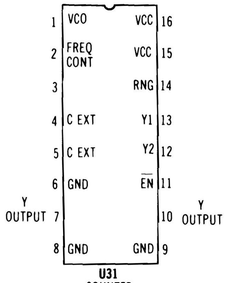

U13, U25
QUAD 2 TO 1 LINE THREE STATE MULTIPLEXER
TOP VIEW

**DM74LS373**



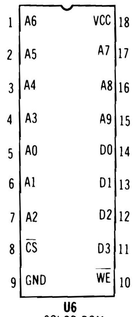

U26
OCTAL D TYPE THREE STATE LATCH
TOP VIEW

**SN74LS629N**



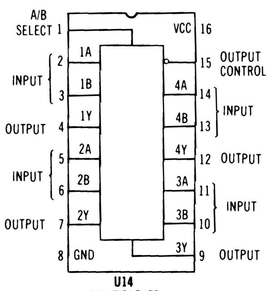

U31
COUNTER
TOP VIEW

**MSM211L-3R3**



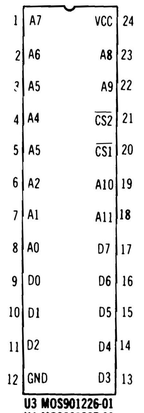

U6
COLOR ROM
TOP VIEW

**SN74LS258N**



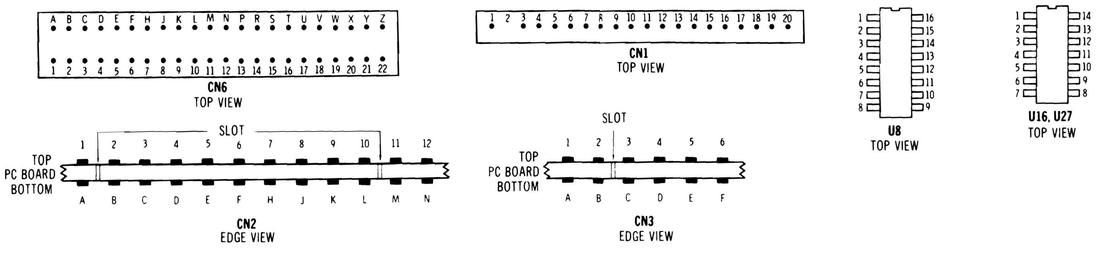

U14
MULTIPLEXER
TOP VIEW

**SN74LS193N**




U3 MOS901226-01
U4 MOS901227-02
U5 MOS901225-01
ROM TOP VIEW

**TERMINAL GUIDES**




## SCHEMATIC NOTES

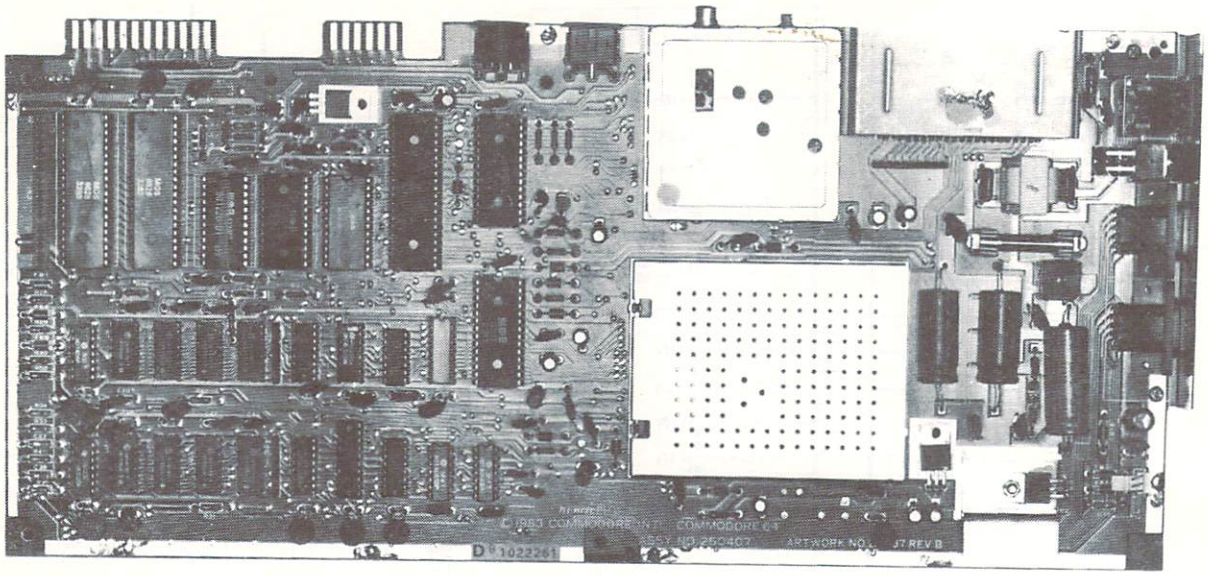
—✕— Circuitry not used in some versions.
- - - Circuitry used in some versions.
⊖ See parts list.
⏚ Ground

Item numbers in rectangles appear in the alignment/adjustment instructions.
Supply voltage maintained as shown at input.
Voltages measured with digital meter.
Voltages and Waveforms taken with computer turned On, no keys pressed, unless otherwise noted.
Waveforms taken with triggered scope and Sweep/Time switch in Calibrate position, scope input set for DC coupling on 0 reference voltage waveforms. Switch to AC input to view waveforms after DC reference is measured when necessary. Each waveform is 9 cm. width with DC reference voltage given at the bottom line of each waveform.
Time in $\mu$sec. per cm, given with p-p reading at the end of each waveform.
Terminal identification may not be found on unit.
Resistors are ½W or less, 5% unless noted.
Value in ( ) used in some versions.

NOTE: Logic probe readings taken with computer turned On, no keys pressed, unless otherwise noted.

Logic Probe Display
L = Low
H = High
P = Pulse
✱ = Open (No lights On)

(1) Probe indicates P when any key is pressed.
(2) Probe indicates P when keys 1, 3, 5, 7, 9, +, &, INST DEL are pressed.
(3) Probe indicates P when keys ←, W, R, Y, I, P, ✱, RETURN are pressed.
(4) Probe indicates P when keys CTRL, A, D, G, J, L, ], CRSR are pressed.
(5) Probe indicates P when keys 2, 4, 6, 8, 0, -, CLR/HOME, F7 are pressed.
(6) Probe indicates P when keys Z, C, B, M, >, SHIFT (R), SPACE BAR, F1 are pressed.
(7) Probe indicates P when keys S, F, H, K, [, =, RUN/STOP, F3 are pressed.
(8) Probe indicates P when keys Q, E, T, U, O, @, ↑, F5 are pressed.
(9) Probe indicates P when keys RUN/STOP, SHIFT LOCK, SHIFT (L), X, V, N, <, ?, ↑ CRSR ↓ are pressed.
(10) Probe indicates P during LOAD and SAVE.
(11) Probe indicates P during SAVE.
(12) Probe indicates L when PLAY or RECORD key is pressed.
(13) Video Interface Chip and Sound Interface Device should have separate ground returns.
(14) C107 is 50pF when used with U19 (MOS6567 versions R4, R4T2).
C107 or C203 is 220pF when used with U19 (MOS6569 version R1).



MAIN BOARD-SHIELD LOCATION

## DISASSEMBLY INSTRUCTIONS

### CABINET TOP REMOVAL

Remove three screws from cabinet bottom. Lift cabinet top and keyboard from cabinet bottom. Disconnect the keyboard connector and the power indicator connector from the main board.

### MAIN BOARD REMOVAL

Unsolder copper strip on the top right side of the cardboard shield and carefully fold back shield. Remove seven screws holding main board to cabinet bottom. Unsolder grounding strip at all nine places on the main board. Remove shield and main board from cabinet bottom.

### KEYBOARD REMOVAL

Remove eight screws holding keyboard to cabinet top. Lift keyboard assembly from cabinet top.

# COMMODORE 64

# CC4

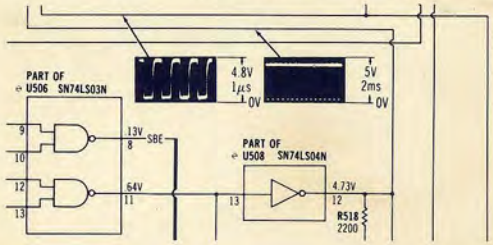
SAMS

If seal is broken, nonreturnable.

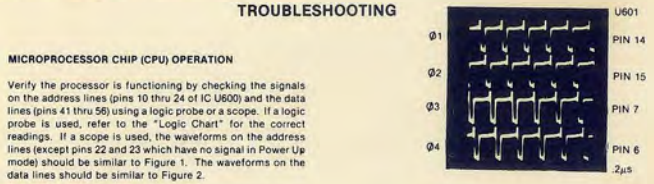
**COMPUTERFACTS™ put easy to use, informative technical data right at your fingertips. Each edition includes specific service information on the individual component, along with some overall troubleshooting hints.**

The following information is just a sample of the many valuable time saving features contained in this exclusive Sams COMPUTERFACTS publication:

- Preliminary Service Checks section is an easy to use, step by step guide for the experienced technician or hobbyist, and even beginners.
- SAMS famous industry accepted standardized notation schematics containing CIRCUITRACE®, GRIDTRACE™, waveforms, voltages and stage identification.




- Step by Step Troubleshooting guides the technician through the necessary procedures to quickly locate the problem.

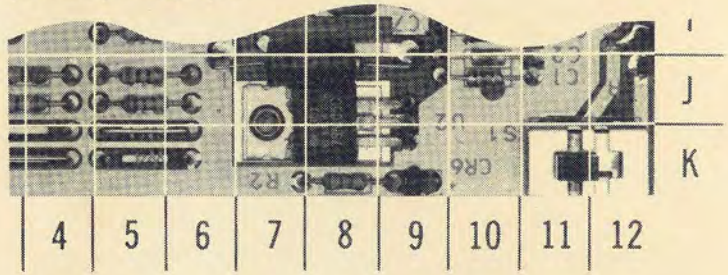



- Complete Components Parts List in an easy to use format with field replacements shown when possible. SAMS unique semiconductor, chip and IC cross-reference gives you many replacements to choose from and is available at your Electronic Distributor.

**SEMICONDUCTORS (Select replacement for best results)**

| ITEM No. | TYPE No. | MFGR. PART No. | REPLACEMENT DATA | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | ECG PART No. | GENERAL ELECTRIC PART No. | MOTOROLA PART No. | NTE PART No. | RCA PART No. | WORKMAN PART No. | ZENITH PART No. |
| D102<br>D103<br>D201<br>D501 thru D503 | 1SS53<br>1N60FM<br>1N4004GP<br>1SS53 | 1149-2576<br>1149-2527<br>1201-4205<br>1149-2576 | ECG519<br>ECG109<br>ECG116<br>ECG519 | GE-514<br>1N60<br>GE-504A<br>GE-514 | 1N4935<br><br>1N4004<br>1N4935 | NTE519<br>NTE109<br>NTE116<br>NTE519 | SK9091/177<br>SK3088<br>SK3312<br>SK9091/177 | WEP925/519<br>WEP134/109<br>WEP157<br>WEP925/519 | 103-131<br>103-Z9001<br>212-76-02<br>103-131 |

- Quick Component Location using the SAMS exclusive GRIDTRACE, CIRCUITRACE, and component photographs.




- Logic Chart containing logic probe readings to isolate defective circuitry and components.

**LOGIC**

| PIN NO. | IC U100 | PIN NO. | IC U100 | PIN NO. | IC U102 | IC U103 | IC U104 | IC U105 | IC U106 | IC U107 | IC U108 | IC U109 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1<br>2<br>3 | P<br>P<br>P | 21<br>22<br>23 | P<br>P<br>P | 1<br>2<br>3 | L<br>P<br>H | L<br>P<br>H | L<br>P<br>H | L<br>P<br>H | L<br>P<br>H | L<br>P<br>H | L<br>P<br>H | L<br>P<br>H |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